LIFE CYCLE COSTS OF THE C-130 ELECTRICAL POWER SYSTEM UPGRADE

THESIS

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Theodore D. Seymour

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Abstract

This research investigated the life cycle costs of three alternative electrical power systems for a planned electrical system upgrade to the C-130 aircraft. Research identified the contractors as (1) Sundstrand, (2) Westinghouse, and (3) Leland. The literature review included discussions on the C-130, electrical power systems and the proposed alternatives, and the elements of life cycle cost analysis. In the discussion on supportability issues, this research evaluated changes in mission capable rates and the needed fleet size to perform the current mission. In estimating Operating and Support costs, this research utilized the analogy approach. Analogies were based on expert opinions of Air Force and industry engineers. Sensitivity analysis performed on the engineers performance predictions aided in the formation of the conclusion.

The system performance of all options netted similar results. However, Alternative 3 had the lowest total life cycle costs, making this the most cost effective option. This research concluded the Leland Proposal to be the best choice and recommends implementation of the proposal.

LIFE CYCLE COSTS OF THE C-130
ELECTRICAL POWER SYSTEM UPGRADE

I. Introduction

General Issue

The United States Armed Forces has always been dependent on military airlift to project its might. Now in the wake of decreasing defense budgets, the United States Armed Forces are moving to a smaller, more efficient, and more technologically advanced force. This new force structure means there will be fewer troops in fewer locations with larger areas of responsibility. Because of this, a greater demand for reliable military airlift to get the troops and supplies where and when needed will exist.

Tactical airlift is one part of military airlift. The C-130, aptly named Hercules, performs the bulk of tactical airlift missions. Over its 30-plus years of service the C-130 has undergone many system modifications, most recently in the avionic systems. The new avionic systems themselves operate superbly; however, these systems are not always available due to the performance of the Electrical Power System (EPS). The obsolete EPS continuously degrades the effectiveness of the C-130 fleet.

This chapter gives an overview of the thesis topic. First, a description of the problem at hand is given. Next, background on the problem is given to demonstrate the importance of the problem. Third, a list of relevant definitions provides a common background needed for this research paper. Lastly, the objectives of this research paper are listed.

Specific Problem

The Electrical Power System of the C-130 is the heart of the entire weapon system. Unfortunately, the C-130 Hercules has experienced problems with power provided by the EPS to the avionic systems. The current EPS causes data losses, premature failure, and damage to the modern solid state avionic equipment. To maintain an effective and viable tactical airlift capability, an alternative EPS must be identified. The best alternative must minimize the EPS power supply problem for the lowest life cycle costs.

Scope

This research paper, in determining life cycle costs, limits the evaluation to the C-130E/H models. This research paper will estimate two types of costs; acquisition costs and operational and support (O&S) costs. In addition, because of limitations of time and accessible data the analysis was performed to show the direction of impact caused by each alternative. Therefore, this project will identify the relative cost preference not a detailed cost estimate for each alternative.

Definitions

Loads. For the purpose of this research, a load is defined as any component (i.e., UHF radio, Doppler Radar, etc.) that draws power from the Electrical Power System.

Clean Power. This will be defined as uninterrupted, constant frequency power to the loads. (34)

Dirty Power. This will be defined as power to loads that is interrupted with non-constant frequency. (34)

Parallel Circuit. This is a circuit where more than one path exists for an electrical current to travel. If the path through one of the circuit elements is broken, the other circuit elements will continue to function (3:11; 36:41).

Series Circuit. This is "a circuit in which the electrical current flows through each circuit element via a single path" (3:352). This implies that if the circuit is broken at any given point all succeeding points are closed to the circuit, thus stopping operation of the circuit.

Series-parallel circuit. This is a circuit where some of the circuit elements are connected in series and some are connected in parallel (3:15).

Busbar. This is a power distribution point to which a number of consumer elements or loads may be connected. It provides a convenient means of connecting positive power supplies to the various loads (36:81). A busbar facilitates switching of loads to different power supplies with out damage to the power supply. The busbar is also referred to as a buss. (3:346)

Mean Time Between Failure (MTBF). This term describes "the average interval of time between component failure" (46:2).

Mean Time Between Removal (MTBR). This term "quantifies the frequency of removing an assumed bad item from the end item , replacing it with a like serviceable item from supply" (46:3).

Mean Time Between Maintenance (MTBM). This term "quantifies the frequency of maintenance performed at the organizational level of maintenance" (46:2-3).

Mean Time To Repair (MTTR). This term is used to represent the average time spent repairing an item/system. It is often used in measuring the maintainability of an item/system.

Work Unit Codes (WUC). This is a five digit alpha-numeric code that identifies the type of aircraft maintenance activity or a particular system/subsystem. An example of a WUC is 51ACO. Where the first two digits identify the system (e.g. avionics) and the last three digits identify the specific component (e.g. doppler radar). (28:5.6)

Maintainability. There are two definitions here for this term. The first from DoD Directive 5000.40, states

> Maintainability is the ability of an item to be retained in or restored specified condition when maintenance is performed by personnel having specified skill levels, using prescribed procedures and resources, at each prescribed level of maintenance and repair. (14:10)

The second definition comes from Maintainability as a System Characteristic, it states

> Maintainability is a characteristic of design and installation which is expressed as the probability that an item will conform to specified conditions within a given period of time when maintenance action is performed in accordance with prescribed procedures and resources. (23:28)

The one common thread is the inclusion of "maintenance performed with prescribed procedures and resources". The first definition, however, makes a distinction between levels of maintenance. This is especially important in the military environment where there is commomnly several levels of maintenance for any given system.

Reliability. A term used in all aspects of the acquisition of systems. It is defined as

> ...a potential capability. Only reachable if the product is manufactured perfectly and operated and maintained under ideal conditions. (32:18)

A system being used under perfect conditions is hardly the case, especially aircraft systems. DoD Directive 5000.40 defines reliability as "The duration or probability of failure-free performance under stated conditions". (14:10)

This probability should be measured in a way that relates to the mission being performed. (7:7) Normally, reliability is measured as Mean Time Between Events. The term events can be substituted with failure (MTBF), removal (MTBR), or maintenance (MTBM).

For the purpose of this research, the number of removals will be used as a measure of the system reliability. The main reason for this stems from the fact that all removals generate a demand on the supply system that must be met by either a replacement or repaired part.

Mission Capable Rate (MCR). This is a measure of an aircrafts readiness to perform the mission when called upon. Mission capable rates are determined by taking the ratio of aircraft available time over the possessed time.

Reasearch Question

1) Which proposed alternative best balances the factors of Life Cycle Cost Analysis?

Conclusion

This chapter has given a general and a specific account of the problem at hand. The scope of this research has been identified the C-130E as the baseline aircraft used for this analysis. Also in this chapter, definitions and/or clarifications of words and terms, that are central to understanding the content of this research, were included. In addition, this chapter has listed the research question that this paper will attempt to answer.

II. Background

The C-130 Hercules

The C-130 Hercules, manufactured by Lockheed, has been in continuous production for over thirty years. "The first flight of the YC-130 Hercules was made on August 23, 1954 and delivery of the C-130A tactical transport began in December 1956" (45:84). To date over 2000 aircraft have been produced for more than 60 nations. It remains the "longest lasting large transport program in history" (24:38).

The C-130 performs a variety of roles; to include gunships, firefighting, airborne command post, disaster relief, and its most notable role of troop/supply carrier. Among its many accomplishments, the Hercules boasts the fact of being "the largest aircraft to land on and take-off from an aircraft carrier" (24:36). In the United States Air Force, the C-130's most vital missions pertains to tactical airlift.

The mission of tactical airlift consists of hauling troops and supplies within a theater (intra-theater). It is also used for redeployment of troops and supplies between theaters. The C-130's importance became evident during the Vietnam War. In addition to intra-theater movement, the C-130 became indispensable by moving supplies between air bases, especially, when no other aircraft could accomplish the mission. As noted by Lt Col Miller, in his book, Airlift Doctrine, "The C-130 thus evolved into a high volume, 24-hour, air logistics service linking the main airfields" (29:314). This single statement demonstrates the impending need for tactical airlift.

In recent years, the military has moved to a more technologically advanced force. In addition, the number of the troops deployed at overseas bases have been diminished. This move to a mobile force has increased the load on the C-130 Hercules. As Mr Sorenson states, in his article Getting Back to Europe: Strategic Lift Needed Now More than Ever, "the forces they are to move have gotten larger and heavier" (44:7). Many aircraft can get troops across the oceans. However, it remains that the only Air Force aircraft capable of tactical airlift is the C-130. Logic dictates keeping the Hercules fleet operating as efficiently and effectively as possible. This operational goal is not being met, putting the C-130 Hercules' important airlift role in jeopardy.

Presently, the new avionic systems on the aircraft are solid state and many are controlled by computer. These new systems cannot operate properly or safely with the current dirty power being supplied throughout the Electrical Power System (EPS) of the C-130.

Electrical Power Systems

An electrical power system is designed to deliver electrical power, both AC and DC, to all aircraft systems requiring power; these systems include life support (oxygen), radar, landing gear, and avionics. In most aircraft, electrical generators supply electrical power.

The operation of each generators is tied to the aircraft engines. The generators supply power to busbars and to inverters which in turn relay the power to the loads. In meeting power requirements and in anormal conditions, an electrical power system should behave in the following ways (34;36:81);

1. Power consuming equipment must not be deprived of power in the event of power source failures unless the total power demand exceeds the available supply.

2. Faults on the distribution system (e.g. fault currents, grounding or earthing at a busbar) should have the minimum effect on system functioning, and should constitute minimum possible fire risk.

3. Power-consuming equipment faults must not endanger the supply of power to other equipment. (36:81)

At present, the C-130's EPS violates all three of the above axioms of behavior for an electrical power system. Paralleling or adding redundancy to the system would improve operations. This parallelling of the generators is effective because,

> "AC generators are synchronous machines. Therefore, when two or more operate in parallel they lock together with respect to frequency" (36:43).

This means that the frequency needed for the loads will remain constant and continuous. (3:81; 6; 36:43-4)

Baseline Configuration. The existing EPS, for the most part, consists of the original 1950's design. It was designed for its reliability and simplicity. However, this system has inherent problems with the technology of today, specifically systems that rely on solid state circuitry and computers. (18:3; 40:6)

The present electrical power system, in use on the C-130, is a four station isolated system. Figure 1 below illustrates this configuration.

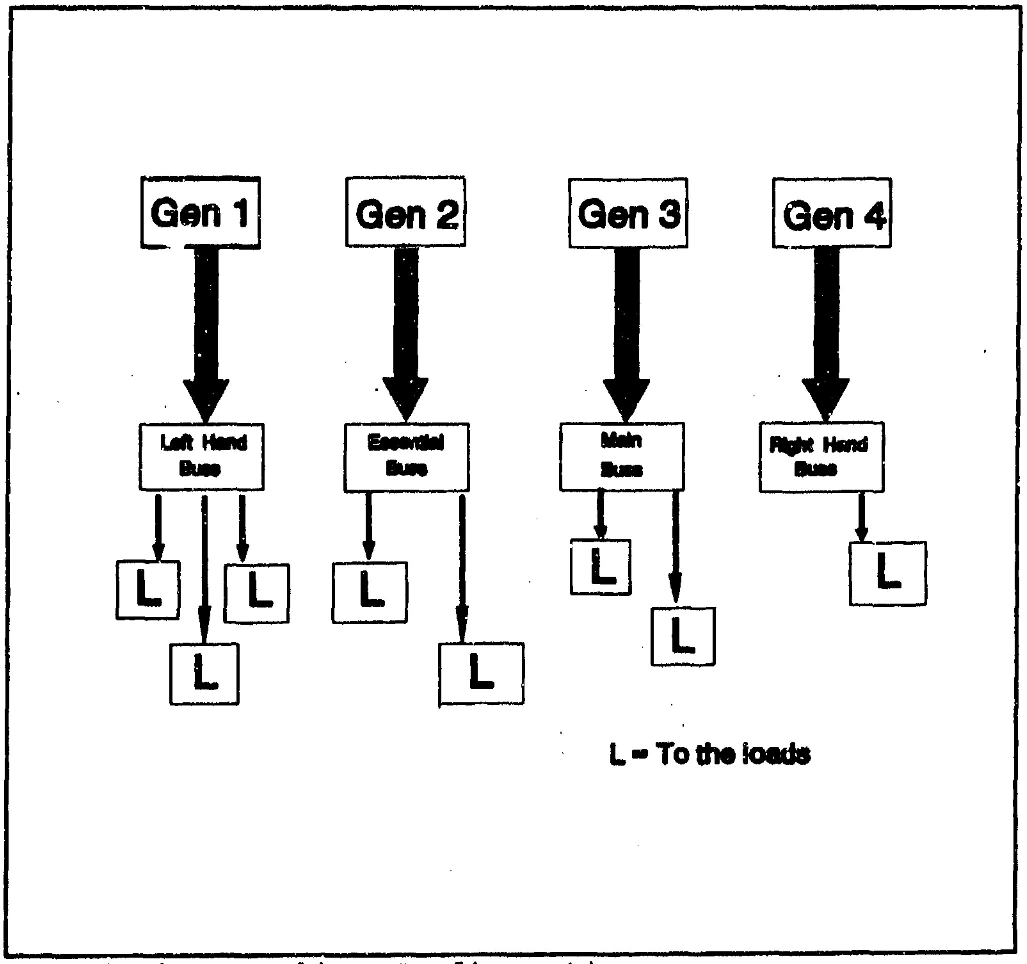

Fig. 1 The Baseline Configuration

It consists of four separate generators supplying power directly to four separate busbars. In turn, each busbar supplies power to specific loads. When a generator drops off-line (not supplying sufficient power) the bus being powered must receive power from one of the on-line power sources. This switching causes the electrical supply to the bus to deplete to zero volts for as long as 5 milliseconds. (34) This short absence of power affects the loads adversely and can result in one of the conditions that follow:

1. System momentarily operates out of tolerance and return to normal when voltage returns to normal.

2. Systems fail to operate and will not return to normal operation without being reprogrammed.

3. Reliability is affected and systems experience premature failure. (26:2)

The problems stated above presents two types of problems. First, it violates the axioms set forth in the previous section an proper operating characteristics of a system. Second, it causes supportability problems.

The first condition, although apparently uneventful, still requires maintenance actions to verify and validate the system integrity. The maintenance actions required could include on aircraft trouble-shooting or even removal of a component to send it to the repair shop. The second and third conditions obviously require immediate maintenance actions to remove and replace the "defective" component. In addition, the maintenance activities of removing and replacing the component, place demands on the supply system. This depletes available spares, increases the need for more spares, and increases the cost of operating the system.

In attempt to alleviate the current problems with the current EPS system, three alternatives have been proposed.

Alternatives

The three alternatives proposed in addition to the existing system actually leave four options for the decision makers. However, throughout the remainder of this research paper the current system will not be listed as an option but, will be referred to as the baseline upon which alternatives are compared and decisions based. The three alternatives to be used for comparison are as follows:

1. The Sundstrand Proposal -- A four channel parallel system using the C-17 Integrated Drive Generator (IDG) System. (26:3)

2. The Westinghouse Proposal -- A four channel parallel Variable Speed Constant Frequency (VSCF) System adopted from the F-18 fighter aircraft. (26:5)

3. The Leland Proposal -- An improved four channel series-parallel system that adds two converters to the current system. (26:3; 27)

Alternative 1--The Sundstrand Proposal. This alternative incorporates technology currently in use on the C-17 weapon system. This alternative includes replacement of the current generators with Integrated Drive Generators (IDG) System. The IDG system combines the operation of generators and voltage regulators in one unit. This system is oil cooled and incorporates a self-test feature. Therefore, if a generator is performing inadequately, it will drop off-line. This automatic feature performs much like the converters in the previous option. (2:2; 26:3) Dropping off-line will not create a problem due to the fact that this system parallels all four generators through an electrical distribution system. Figure 2 illustrates the proposed configuration of this alternative.

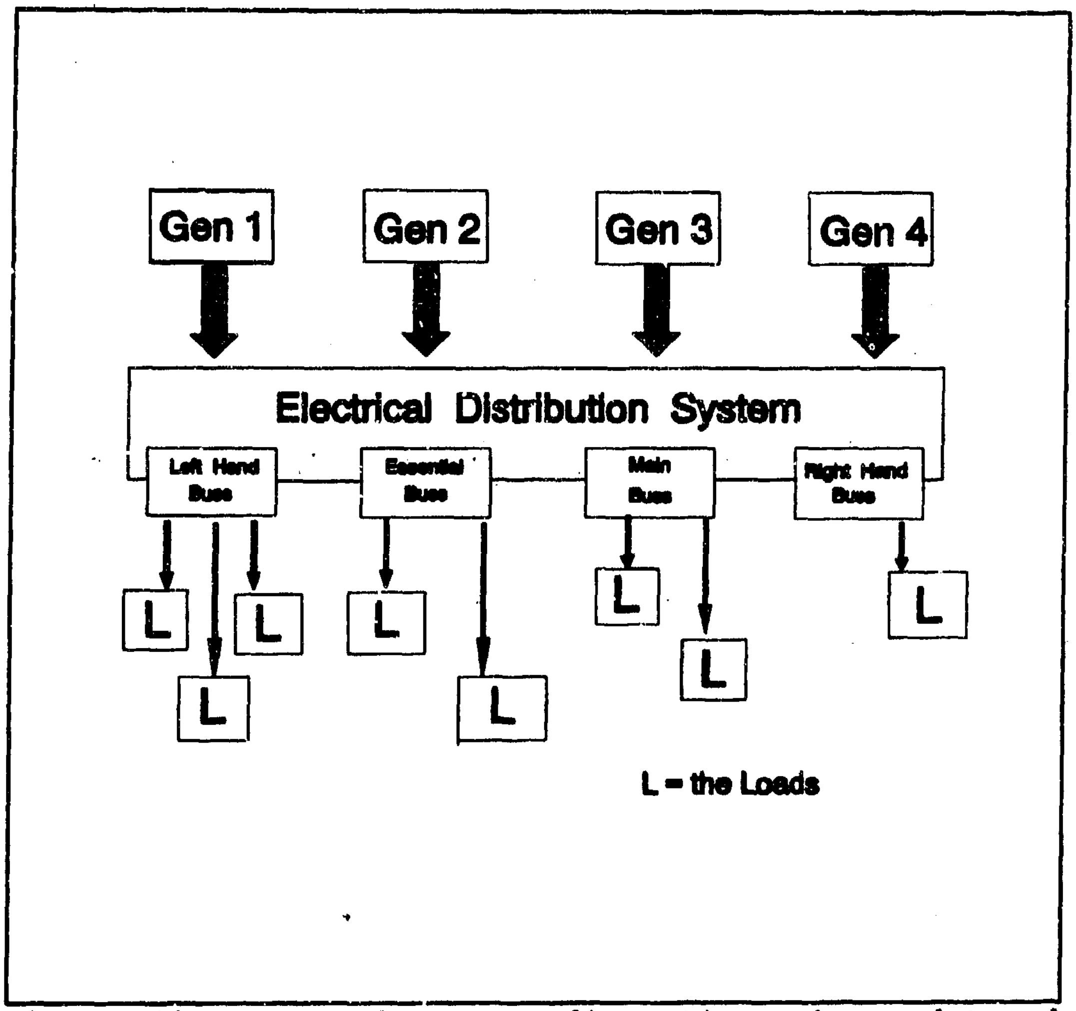

Fig. 2 Illustrates the IDG configuration--The Sundstrand Proposal

All power sources feed into the electrical distribution buss. Because the loads can obtain power from any of the four sources, the entire system is in parallel. In essence, if one generator drops off-line it has no effect on the system because there are still three generators supplying clean power to loads.

This alternative would use the same hardware developed for the C-17. Modifications will need to be accomplished in the engine nacelle areas to accommodate an adaptor gearbox and larger generators. In addition, extensive rewiring will be required. (27:8)

Alternative 2--The Westinghouse Proposal. This alternative incorporates technology presently used on the F-18 weapon system. Like the previous alternative, this one parallels the entire system. Figure 3 on the next page depicts the proposed configuration of this system. The main difference between the this and the first proposal is that the this system utilizes an electrical conditioning circuit (ECC). (27:6)

The generators are replaced by a Variable Speed Constant Frequency (VSCF) system. This includes new generators, Generator Control Units (GCUs) and voltage regulators. The GCUs and regulators perform together as the electrical conditioning circuit mentioned above. These electrical conditioning circuits can receive variable speed frequency from the generators and "clean it up" for use by

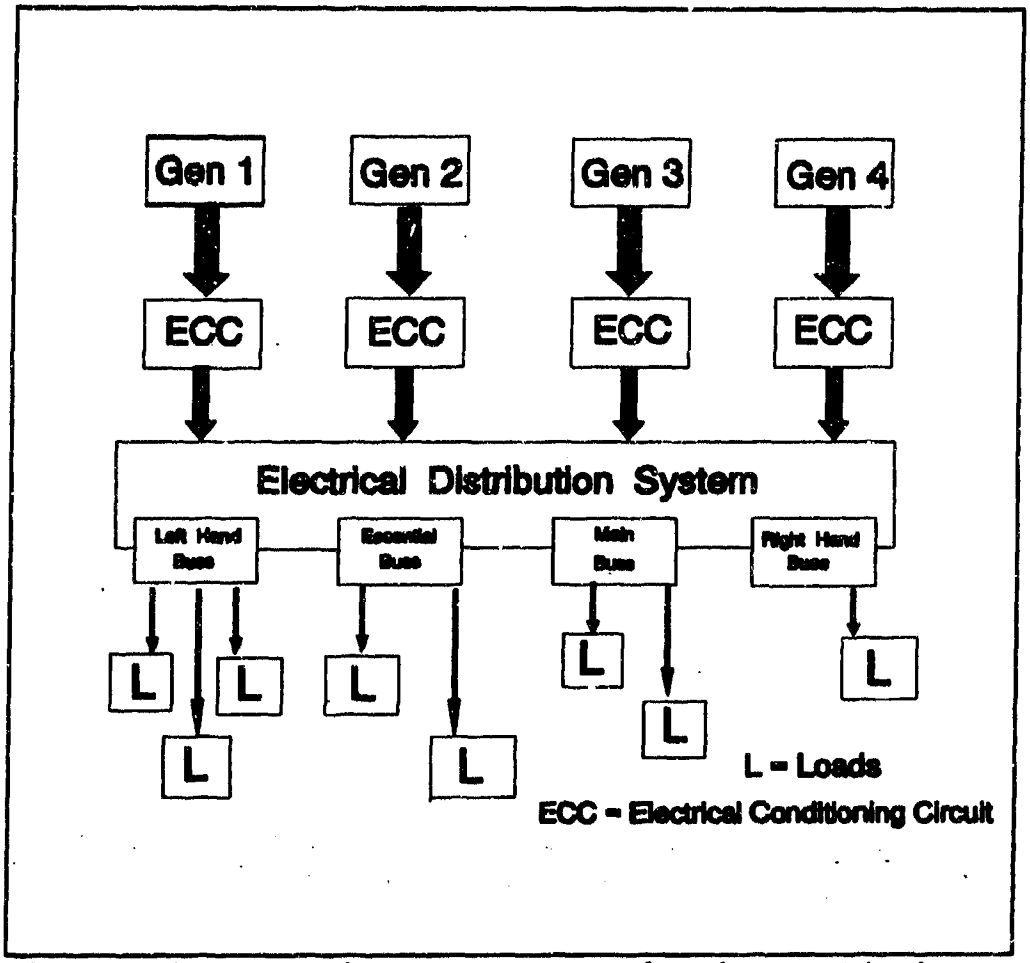

Fig. 3 Pictures the VSCF proposal--The Westinghouse Proposal

the loads. This system allows for slow engine RPM and spikes, while enabling the conditioning circuits to supply clean power to the electrical distribution buss. (27:6; 38:3)

As with alternative two, this option requires extensive rewiring and major modifications to the engine nacelle areas. This alternative makes maintenance more difficult due to unintentional ground loops that make it difficult to isolate faults. (27:7)

Alternative 3--The Leland Proposal. The last alternative utilizes a two channel parallel system. Where two generators, one from each side of the aircraft, are connected to a single converter. Because there are two sources at each converter indicates a parallel relationship. Figure 4 is an illustrates this improved configuration. The switches take the generators AC power

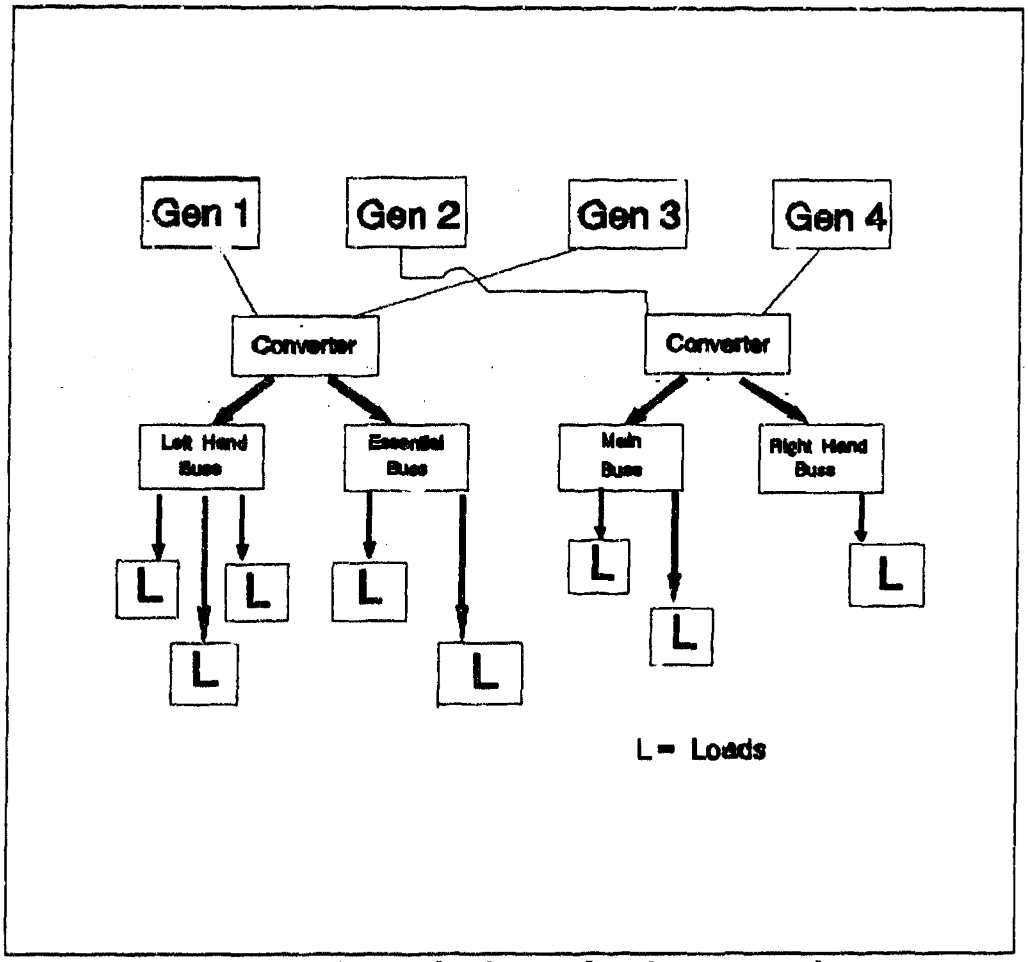

Fig. 4 Configuration of the Leland proposal

and convert it to the required DC power. Internally, each converter constantly evaluates the input frequencies. This process keeps the internal buss supplied with clean power allowing the converter to supply clean power to the loads. The two channels are connected in a series manner. This two channel parallel system can also be described as series-parallel.

There is minimum rewiring needed to accommodate the converters and there are no major modifications required to any of the existing system. This alternative will supply clean, 120 volt, power to the loads. (2:4:38:4)

The three alternatives discussed, as well as the baseline (current system), form the basis of the life cycle costing and sensitivity analysis to be performed in this research paper.

Life Cycle Cost Management

Life Cycle Cost Management (LCCM) can be traced, in the Department of Defense, to the mid 1960's. At this time, DoD officials realized that operational and support costs of weapon systems were "consuming a large portion of the budget" (17:2). Part of this 'large consumption' occurred, in part, as a result of increasing system complexity, increasing uses for existing systems, and constantly changing technology. These factors coupled with the "increasing concern over the consequences of competitive procurement without regard to total system cost" (15:1) marked the genesis of LCCM within the DoD. (15:1-3; 10:1)

Development of LCCM. The birth of LCCM entailed a major shift in the focus of DoD acquisitions. Before LCCM, performance of the was the driving factor in system design. This parlayed into decision-makers being primarily concerned with procurement costs of the weapon system. Now, because of LCCM, the focus is on the total life cycle cost of the weapon system. This translates into a new acquisition process where "cost is a parameter equal in importance to technical performance, supportability, and schedule requirements" (10:1). Within this framework, special attention is focused on operating and support (O&S) costs. This focus is due to the fact that O&S costs account for more than 50 percent of the total life cycle costs of a weapon system. (1:4; 37:16; 39:36)

Figure 5, on the next page, crudely illustrates the difference in the amount of money spent in each of the four life cycle phases of a weapon system. The overlap of the cost curves was placed in the figure purposely to illustrate that the costs are incurred throughout different phases of the life cycle

Life Cycle Cost Management constitutes more than trying to lower O&S costs. LCCM is a balancing act of four main factors; cost, schedule, performance, and supportability. (16:1-3; 41:8)

The concepts behind LCCM are even more relevant today. With decreasing defense budgets, it is imperative for the

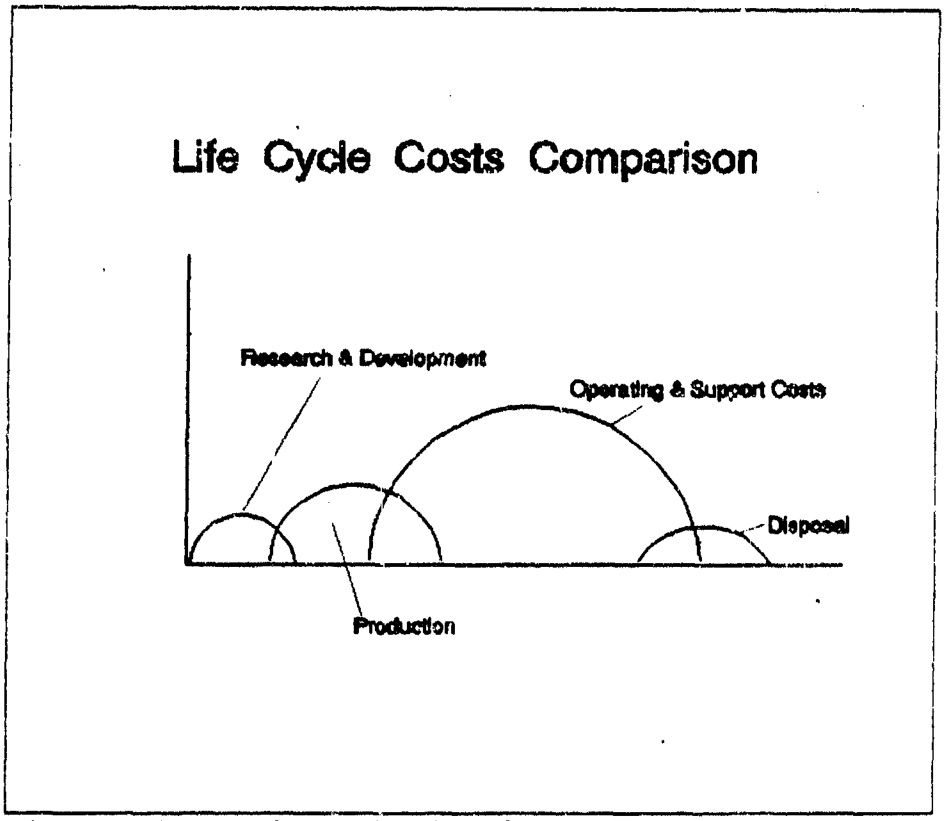

Fig. 5 Shows the relationship of LCC Costs

military to spend every dollar wisely and instead of buying the best possible system the focus must be on buying the most system for the available money. (1:4; 41:8)

Introduction of VAMOSC. As a result of the focus on total life cycle costs, specifically O&S costs, the DoD identified a need for O&S costs to visible. In 1975, DoD Management by Objective (MBO) 9 was issued. This MBO stressed the need to reduce O&S costs. A subset of this, MOB 9-2, entitled DoD Requirements for Visibility and Management of Support Costs, marked the beginning of the Visibility and Management of Support Costs (VAMOSC) system. (17:1-2; 37:16)

> The purpose of VAMOSC is to provide a means to allow visibility of weapon system operating and support costs so that others may manage them, and reduce and control system life cycle costs. (9)

The present VAMOSC system contains two subsystems. The first, Weapon System Support Costs (WSSC) system, collects operating and support cost data at the Mission Design Series (MDS) or system level. Second, the Component Support Cost System (CSCS) collects O&S cost data at the specific subsystems/components level. Costs are collected by National Stock Numbers (NSN) and associated with the proper Work Unit Code (WUC). (9; 17:2-4)

The data bases used within the VAMOSC system are used to aid decision-makers in estimating costs for weapon system modifications and to help estimate LCC of new weapon systems. This is very important when trying to estimate life cycle costs.

Because life cycle costing (LCC) is the reason for the LCCM program, understanding the basis of life cycle costing is important. The definition upon which this research builds comes from Air Force Regulation 800-11, which defines LCC as "The total cost to the government for a system over its full life. It includes the cost of development, procurement, operation and support, and disposal" (10:1).

Managers use LCC in many different ways. One use evaluates the costs of a single system. Used in this way, life cycle costing addresses the aggregate of all costs to calculate the total cost for a specific problem (4:176). Another use involves using LCC to evaluate and choose between several alternatives. Used like this, LCC becomes a powerful decision-making tool. Using LCC to evaluate alternatives continues as the most common application of LCC in the Air Force (44:6).

The shift from acquisition based on procurement cost to acquisition based on total life cycle cost constitutes the main reason for using LCC. Noting the significance of costs in today's world, it becomes even more important to understand the elements of life cycle costing. In his book, Life Cycle Costing: A Better Method of Government Procurement, Mr. Seldon states the following:

> LCC is the search for the significant costs that can be influenced by planning and design decisions. Therefore, a major task of LCC analysis is to discover and illuminate such cost drivers. (42:18)

Cost Drivers. In order to determine life cycle costs or develop a cost model, correctly identifying those factors that drive costs becomes imperative (20:6-7). A good working definition of cost drivers is "those activities that cause the incurrance of costs" (31:42). Cost drivers affect LCC at many levels of evaluation and come from many different sources. Cost drivers can be as broad as maintainability requirements or as narrow as the type of nuts and bolts to be used. Prime examples of cost drivers include: maintenance, spare parts, modifications, personnel and training (30:5). The problem remains identifying the pertinent cost drivers, isolating them and including them in a costing model (42:18).

Identifying cost drivers gives managers the chance to minimize the effect of those cost drivers. This signifies special importance to minimizing costs that affect the operational and support phase because over 50% of total life cycle cost is incurred during this phase (30:4). Logically, reducing operational and support costs remains the best way to decrease total life cycle costs; however, one must be careful not to degrade system performance of the system when attempting to reduce costs. (43:12-13)

Once cost drivers have been identified, the next step is to determine how they relate to the total life cycle cost. In many cases, this relationship must be estimated. These estimates are known as cost estimating relationships.

Cost Estimating Relationships. Cost estimating relationships (CER) form the core of a cost estimating model. A formal definition of a CER follows:

> A CER is an equation which attempts to define the relationship between resources required to produce a system and the physical and/or performance characteristics of the system and/or the process required to produce the system. (33:20)

In simpler terms, "CERs are rules-of-thumb which relate cost to cost generating variables" (4:38). In order to be effective, CERs must contain the cost drivers relevant to total cost. Determining the appropriate cost drivers remains a problem for any analyst attempting to develop a

CER. This is due to the fact that little information normally exists about specific costs when developing CERs. The effectiveness of cost estimating relationships in times of scarce information can be attributable to logical structure of CERs (33:20).

Cost estimating relations normally fall into three main categories; parametric, analogy, and engineered. (35:3-1) In addition, "cost estimating relationships can take on many forms; i.e., continuous or discontinuous, mathematical or non- mathematical, linear or nonlinear, etc" (4:38).

Of the many types of CERs, linear form is the most popular. An example of a linear CER is as follows:

$$C = n + mx \tag{1}$$

where

C is the total cost

n,m are numeric constants

x is a cost driver (independent variable)

Parametric Estimating. Parametric estimates are often used for developing CER's. Many times, these CERs use more than one independent variable (cost driver) to determine the total cost. This is referred to as multiple correlation. In this instance regression analysis is utilized to determine the relationship between the variables. This type of estimate is difficult to develop but, is very easy to use. In addition, computer programs that use regression analysis are abundant and fairly simple to use. (21:120-122; 33:21; 35:3-6-7; 42:21) Following is an example of a multiple correlation linear equation:

$$C = n + mx1 + lx2 \tag{2}$$

where

C is the total cost

l,m,n are numeric constants

x1,x2 are independent variables (cost drivers)

<u>Analogy Estimating</u>. This type of estimating is commonly used in the field. For this type of estimate,

> A system currently in the field is identified. The cost of the new system is then developed by taking the cost of the old system and adjusting it for the difference between the two. (28:3-7)

To show this, take equation one and calculate a CER for the cost of the new system x,

$$Cx = z + 1/2y \tag{3}$$

where

Cx is the total cost of the new system x

z,y are cost associated with the old system

One draw back of this type of estimating is that it relies heavily on expert opinion. CER's also provide for a statistical estimate of the accuracy of the equation whereas, analogies generally lack this estimation of accuracy.

Engineering Estimating. Also known as the 'grass roots' method, this type of estimating is the most expensive to develop in terms of money and time. It attempts to account for all actions that contribute to cost and develop an accurate assessment. (13:3-6-8) For an analyst to use this type of estimating technique, there would need to be lots of time and data available. This technique often utilizes one or more of the previously mentioned techniques in the development of estimates. Like cost drivers, identifying CERs as early and accurately as possible allows the analyst to identify potential high cost areas and affords him/her the opportunity to minimize the overall cost. This becomes especially important for CERs relating to operational and support costs because of the weight O&S has in the overall life cycle costs of a system (39:36; 42:107). Developing CERs remains a difficult thing for analysts. However, once developed, CERs become the catalyst to determining the effectiveness of the cost model.

Models. Models can take many forms, through the use of different estimating methods. Many times in LCC, the main model contains many sub-models or sub-routines that combine in defining the overall model.

Simply stated, a model is an "integrating device designed to facilitate the analytical process" (21:66). Effective models represent real world problems in a timely, efficient, and economical manner. Ease of using facilitates the use of models in decision-making (28:159-165). Within the confines of LCC cost estimating, there are three types of models to discuss: cost models, accounting models, and estimating models. "A cost model is a method, based on technical and programmatic parameters, of estimating costs" (42:157). Cost models must contain all pertinent factors while allowing for the suppression of negligible cost factors (21:9). Cost models are broad in scope; thus, they are comprised of many models or sub-routines. The subroutine estimates costs in a narrow or specific area. The compilations of all the sub-routine cost estimates yields the overall estimate for the cost model. Usually, in a cost model, the top level of estimates is added to determine the total cost estimate. An example of this follows:

$$CLCC = CD + CP + COS + CL \tag{4}$$

where

CLCC is the total life cycle cost

CD is the total cost of development

CP is the total cost of procurement

COS is the total cost of operation and support

CL is the total cost of disposal

This type of mathematical structure, adding all the elements, is known as an accounting model (42:158). To derive the elements of the accounting model, cost estimating relationships are employed. "Addition of the cost estimating relations for each element to the mathematical structure yields an estimating model" (42:158). Using equation (4), this means that each element (i.e. development) is the derivation of a CER. This appears to be the most common structure, but accounting models elements can be derived from other accounting models. Further, as mentioned earlier, CERs can result in other CERs. There exists no set structure for developing cost models. Much depends on the analyst building the model.

In the development of a good cost model, an accurate Cost Estimating Structure (CES) must be developed. A CES identifies the cost drivers and simplies cost estimating through categorization. Dividing the costs into categories allows the analyst to isolate specific areas of interest. (22; 35:14) Cost categories beyond the scope of this research, such as aircrew pay and base level support will be held constant using dollar values extracted from AFR 173-13. Air Force Regulation 173-13 contains the format of an Air Force approved CES used in most cost estimates. The CES in AFR 173-13 acts as the final level or accounting model. It is comprised of many indenture levels that utilize CERs to determine costs for each category of cost (Cost Driver). This format is a prime example of how all the elements discussed under LCC intertwine to develop cost estimates.

Although the most important aspect of the model may be the cost drivers and CERs, not the structure, having a well defined structure ensures the analyst looks at all possible cost drivers. A model containing the appropriate subroutines makes it easier for the analyst to identify areas requiring attention. A properly built model also allows easier application of sensitivity analysis (4:80-85; 21:9-10).

Conclusion

This literature review discussed three main areas. It started with a discussion of electrical power systems and the current C-130 power system or baseline. This section explained the purpose of aircraft electrical systems and demonstrated the problems with the current system.

The second part of discussion in this chapter dealt with the proposed alternatives to the baseline. Discussion highlighted the main features of each option and the changes that would be necessary to implement each option. The final section of this chapter discussed life cycle cost management and its main elements. Discussion started with the definition of LCCM and a short history of its evolution. During this discussion the development, purpose, and objectives of the VAMOSC data system was also highlighted. Next, this literature review discussed the elements of cost estimating; cost drivers, cost estimating relationships, and cost modeling. In this discussion the review demonstrated how the elements of LCC interact and interrelate in determining life cycle costs.

III. Methodology

This chapter outlines the processes and the methodology used to meet the objectives of this research set forth in Chapter I. Included in this chapter are the steps taken to identify the problem, acquire the needed data, and estimate the life cycle costs. Estimating life cycle costs is dependent on three main aspects; schedule performance, and supportability. The steps taken to identify these areas will be outlined. Lastly, the process involved in performing sensitivity analysis will be presented.

Problem Identification

The first step in identifying the problem was accomplished through both personal and phone interviews. Conversations with the C-130 Systems Program Management Office, Warner Robins AFB, GA and HQ AFLC, Tactical Airlift Division identified the need for a life cycle costs comparison among alternatives for an updated electrical power system for the C-130 aircraft. Continued interviews revealed that there were three options being considered. As described in Chapter II of this research, the options are as follows;

1) The Sundstrand Proposal--The four channel parallel IDG System.

2) The Westinghouse Proposal-- The four channel parallel VSCF System.

3) The Leland Proposal--The improved isolated two channel parallel generator system (series-parallel).

The three alternatives listed were compared to the current electrical system referred to as the baseline for the rest of this research paper.

Before going further, the problem identification had to include the effect of a new EPS on the aircraft systems/subsystems. First, the EPS itself, obviously, is most affected. Improvements in the system would supply clean power to systems requiring electrical power. (6; 25; 34) Second, the systems effected by the EPS are all systems requiring electrical power, more specifically avionic/electronic systems. Conversations with engineers at the C-17 and C-130"J" System Programs Offices (SPOs), Wright-Patterson AFB, OH and the C-130 Systems Program Management Office, Warner Robins AFB, GA revealed that the performance of the identified systems, with the inclusion of any of the alternative EPS's, would increase mean time between removal approximately 15 per cent. (6; 25; 34)

The problem was to determine the best option based on the balance of lowest total life cycle costs, best increase in performance, and supportability.

Data Collection

As noted in the problem identification section of this chapter, there were two types of cost to estimate, procurement costs and operating and support costs.

Consequently, there were two distinct paths to follow in gathering the needed data.

The first was to gather procurement cost data on the three alternatives proposed. This entailed contacting Lockheed Aeronautical Systems, Inc., to attain accurate cost data. Lockheed Corporation, as the primary contractor for the upgrade, supplied the data needed to proceed with the procurement cost calculations.

Retrieving the second type of data, that for O&S costs was not as straight forward. First, it was necessary for the engineers to identify the systems most affected. As a group they identified the avionics/electronics as the most affected by the EPS. The next step was to identify the corresponding Work Unit Code for the affected systems. Retreiving this data involved the use of technical order C-130A-06 to identify the appropriate Work Unit Codes for each system/subsystem. WUCs are necessary because virtually all Air Force data bases associated with aircraft systems store data by WUCs.

This research required access to separate types of data bases. First, the VAMOSC data base was accessed to retrieve cost data associated with the C-130 aircraft and the identified WUCs. Second, reliability and maintainability (R&M) data was required to associate the proper supportability costs with weapon system performance and for use in determining supportability issues. Reliability and maintainability data was acquired from the

C-17 SPO. The data base utilized was the Maintenance Operational Data Automation System (MODAS). This system is currently the main source of historical R&M data used in the C-17 and C-130 SPOs.

Factors of Life Cycle Analysis

Life cycle cost analysis is an attempt to identify and balance four factors--supportability, performance, cost, and schedule. Figure 6 illustrates this balance.

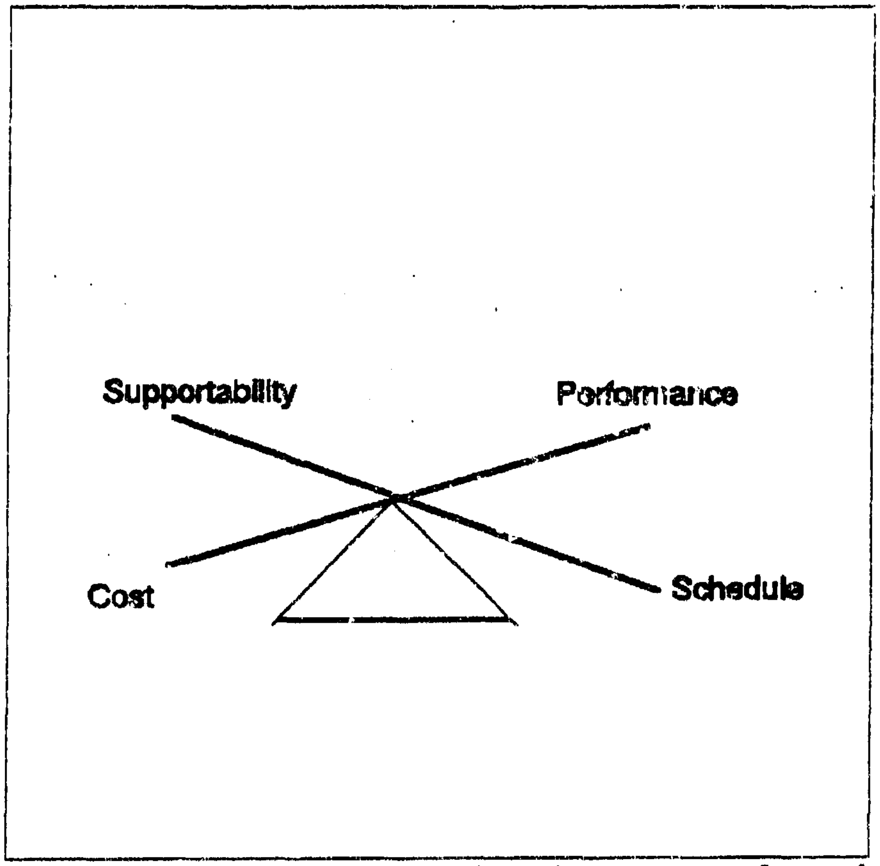

Fig. 6 Illustrates the balancing act performed in life cycle cost analysis

This figure depicts the fact that trade-offs must be made in all categories to ensure the most cost effective program. The following sections highlight the steps taken to identify these factors.

Performance. The main reason for this proposed upgrade is for safety of flight. Presently, the EPS is not meeting the specifications for constant, smooth electrical power set forth by MIL-STD-704D. Each of the alternatives enables the EPS to meet and/or exceed the specifications.

Alterative 1, The IDG System meets the standards but, the EPS has a slightly higher rate of failure than the existing system. The increase is only .8 per cent; however, this was estimated to increase the repair and replenishment spares costs. An increase in maintenance manhours was estimated to occur because of the increased need for both preventative and corrective maintenance actions. In addition, this alternative was found to need special support equipment not presently at bases in sufficient amounts, therefore raising the cost of support equipment. (38:2)

Alternative 2, the VSCF System was also found to need the special support equipment mentioned in the the narrative for Alternative 1. However, the failure rates were found to be consistent with baseline's failure rates. That is, the change was an increase of .006 per cent not a significant delta. Because of this, there was no appreciable change in the cost of repairs or replenishment spares. Preventative (scheduled) maintenance would increase due to the the increase in the number of components in the EPS causing a slight increase in maintenance costs. (Pylant:3)

Alternative 3, The Improved Isolated Generator System, was estimated to have a decrease in the system failure rates. Because of the introduction of new parts, preventative maintenance was estimated to increase but the improved failure rates will decrease the need and cost of corrective maintenance. Decreased failure rates were also estimated to decrease requirements for replenishment spares and support equipment (due to decreased usage). (34; 33:4)

Schedule. The schedules for all three options were determined to be similar. The schedule includes delivery of approximately 600 packages (all C-130 models) over six years (100/year). However, this research only deals with the portion to be delivered to the C-130E models. There are currently 167 C-130E models in the Air Force inventory (excluding ANG and reserve). Dividing this number by six yields 27.78 packages per year. To make this realistic, the number was rounded to 28 packages per year. (34) Therefore, each alternative was assumed to follow the same schedule, 28 packages per year.

Life Cycle Costs. This section details the steps in estimating the costs associated with this research with respect to the factors of a life cycle cost analysis.

Estimating the life cycle costs of the proposed alternatives required extensive historical data. However, before collecting the needed data it was essential to determine how the costs were to be estimated. As mentioned previously, AFLC was concerned with two types of costs, procurement and O&S. This facilitated a separate approach for each element of the total cost. The first element, the procurement cost is derived from simple mathematical equations based on information given directly from the contractor. Second, the O&S costs requires the use of mathematical equations based on R&M and cost data obtained from organic Air Force organizations.

Procurement Cost. The procurement cost were the easiest of the costs to estimate. That is because the cost per alternative was supplied by the primary contractor, Lockheed. The costs for each proposal were subdivided into two cost categories, recurring and non-recurring. The equation developed to estimate the procurement costs follows

$$PC = NR + (Q*R) \tag{5}$$

where

PC = procurement costs

NR = non-recurring costs

Q = total quantity of modification packages

R = recurring costs per modification package

This equation is very straight forward and could only be used to estimate costs using the current year's dollars. It was therefore necessary to develop an equation that could estimate costs using present year dollars.

Present year dollars are dollars discounted for the value of the monies opportunity cost. Discounting takes into account the fact that a dollar today is worth more than a dollar tomorrow. It is defined as

> A financial management tool used to determine the value today (present value) of all net resource flows over the life of a program or project. (11:9)

In Air Force cost analysis a standard discount rate of 10 percent is applied. The use of discounted present year's dollars methodology allows the government to make decisions, on alternatives, knowing the baseline for each alternative is the same. With this in mind, a new equation was formulated that included the use of a discount factor. Multiplying this year dollars by the discount factor yields present year dollars. The resulting equation is as follows

$$PC = NR + (Q)(R) + \sum ((Q_n)(R_n * DF)) \qquad (6)$$

where

PC = procurement costs

NR = non-recurring costs

Q = quantity delivered first year

R = recurring costs per unit first year

R_n = recurring costs per unit for the nth year

Q_n = quantity delivered in the nth year

DF = discount factor

This equation was used to combine the initial costs (non-recurring) and the subsequent recurring costs for each option. The discount factors used in this equation were taken from Air Force Regulation 173-15, Economic Analysis and Program Evaluation for Resource Management. Table 1 shows the discount factors for the first ten years of a project.

Table 1.
DISCOUNT FACTORS
(10 Percent Mid-year)

Year	Discount Factor	Uniform Annual Cost Factor
1	.9535	.9535
2	.8668	1.8202
3	.7880	2.6082
4	.7164	3.3246
5	.6512	3.9758
6	.5920	4.5678
7	.5382	5.1060
8	.4893	5.5953
9	.4448	6.0401
10	.4044	6.4445

This table shows two factors, the first column is used to translate costs to present value when incurred costs are different for each year. The second column is used to translate costs to present value when the incurred costs are the same or uniform in each year.

Operating & Support Costs. Developing an Operating & Support (O&S) Cost estimate entailed a two step procedure. The first step included collecting data and identifying the relevant categories of cost. The second step was to derive the cost formulas.

Steps for collecting the needed data were outlined above. This data was used to derive cost estimating formulas for computing the deltas in cost attributed to the EPS.

The next step was to identify the relevant logistic cost categories. These categories are identified in Table 2 below. This table is not an all inclusive list, for example depot costs are conspicuously absent. This is because not enough useable information was attainable to make estimates in this area. The list does include enough to indicate the direction of impact that the alternatives will have.

Table 2.
Relevant Logistic Cost Categories

Abort Costs
Replenishment Spares
Condemnation Spares
Repair Costs
Transportation Costs (2nd Destination)
Base Level Maintenance Manhours

Calculating repair costs was straight forward. The delta in this category was found by identifying the current (baseline) costs of the affected avionic systems through VAMOSC data base reports. Next, the baseline cost was multiplied by the complement of estimated percentage change in costs. This relationship was expressed as follows

$$Cost_A = Cost_B - (Cost_B)*(1-PF) \qquad (7)$$

where

$Cost_A$ = the adjusted repair cost for that category

$Cost_B$ = the baseline repair cost for that category

PF = the percentage of change estimated in that cost category

This formula expresses the logistic cost deltas in terms of cost savings. Therefore, negative numbers indicate a cost increase.

Data for replenishment costs was in terms of total cost as opposed to being broken down into costs attributed to WUCs. This meant developing an estimating formula to compute the delta. This was done by calculating the ratio of total removals to the removals attributed to the affected avionic systems. Then this ratio was applied to the replenishment spares cost total found in the VAMOSC data base. These steps are expressed in the two simple formulas that follow

$$P_A = R_A/R_T \qquad (8)$$

$$RSC_A = RS_T*P_A \qquad (9)$$

where

P_A = percentage of removals of affected systems

R_T = total removals

R_A = number of removals of affected systems

RSC_A = replenishment spares costs of affected systems

RS_T = total replenishment spares cost

Removals were used again in the calculation of base level maintenance manpower. This estimating formula was the product of the number of removals of affected systems times mean manhours to repair times the cost per hour of labor. This product was then subtracted from the total base level organizational maintenance cost. The following formula shows the expressed relationships

$$MHC_B = (R_A)(MMHTR)(Cost_L) \tag{10}$$

$$Base_{AC} = Base_{MC} - MHC_B \tag{11}$$

where

MHC_B = base level maintenance manhour cost

MMHTR = mean maintenance manhours to repair

$Cost_L$ = average hourly labor cost

$Base_{AC}$ = adjusted base level maintenance cost

$Base_{MC}$ = base level maintenance costs

Condemnation spares costs were figured differently. The initial numbers of condemned assets were derived from the MODAS data system. The cost information for condemnation spares was only available as a quarterly total. At this point, it became necessary to estimate the total cost of condemnation spares. First, the quarterly flying hours were divided by the years flying hours to develop a ratio. The next step entailed dividing the quarterly condemnation spares cost total by the ratio of flying hours, this resulted in the estimated yearly condemnation spares cost. This estimate was based on the assumption that the ratio is constant throughout the year. The third step was to determine the ratio of total condemnation spares to condemnation spares of the identified avionic systems. Finally, this ratio was multiplied times the estimated yearly total costs. The resulting product is the cost of condemnation spares for the identified avionic systems.

$$FH_R = FH_Q/FH_Y \tag{12}$$

$$CS_Y = CS_Q/FH_R \tag{13}$$

$$CS_R = CS_I/CS_T \tag{14}$$

$$Cost_{CS} = CS_R*CS_Y \tag{15}$$

where

FH_R = the flying hour ratio

FH_Q = the quarterly flying hours

FH_Y = the yearly total flying hours

CS_Y = the estimated aircraft total condemnation spares cost

CS_Q = the quarterly aircraft condemnation spares cost for the identified avionic systems

CS_R = the ratio of condemnation spares (units)

CS_I = the number of condemnation spares for identified avionic systems

CS_T = the total number of condemnation spares

$Cost_{CS}$ = the cost for condemnation spares of the identified systems

The next category is 2nd Destination Transportation costs. This is the category of costs associated with the shipment of spare parts to bases and the shipment of repair parts to the depots. These costs were stored in VAMOSC but, like condemnation spares were only available in a quarterly number. The same process of calculating ratios was used to determine the yearly total cost. Next, the number of Not Repairable This Station (NRTS) and condemned base level items were retreived from the MODAS data base. The next step entailed finding the ratio between the weapon system total and those attributed to the identified avionic systems. The last step for both condemnation spares cost and transportation cost was to utilize the same simple formula that was used for the repair costs.

The final category, abort costs, must be calculated differently. A mission abort is the result of unplanned end to the mission due to (1) system failure, (2) absence of needed parts, or (3) lack of maintenance capability. For this research, aborts were quantified in terms of all costs attributable to sortie generation. Determining the effects aborted missions would have on costs developed into a multi-step procedure. First, the number of aborts associated with the affected systems needed to be found.

This number then needed to be multiplied by the cost per sortie and then the percentage of change in performance. The resulting number identifies the cost savings that could be realized from the performance change in the identified avionic systems. This formula is as follows

$$Cost_{PS} = Cost_{TA}/Sortie_{P}$$

$$Abort_{S} = (Aborts_{A})(Cost_{PS})*PF \qquad (16)$$

where

$Cost_{PS}$ = the cost per sortie

$Cost_{TA}$ = the total cost to operate system

$Sortie_{P}$ = present number of sorties

$Abort_{S}$ = the savings attributable to aborts

$Abort_{A}$ = the number of aborts induced by the affected systems

PF = Performance change factor

These formulas used to determine the deltas in the relevant cost categories, including abort costs were the main focus of uncertainty in this analysis. Therefore, to account for this uncertainty and show the direction of impact of changing the percentage of change used to compute these deltas sensitivity analysis was performed.

Supportability. The supportability of a weapon system remains a function of the systems reliability and maintainability. As defined in Department of Defence Directive 5000.39, supportability is

> The degree to which system design characteristics and planned logistics resources, including manpower, meet system peacetime readiness and wartime utilization requirements. (12:2-2)

With this in mind, it was necessary to try to define readiness as a characteristic of supportability. Readiness or operational readiness was defined in the <u>Compendium of Authenticated Systems and Logistics Terms, Definitions, and Acronyms</u> as

> The capability of a unit, ship, weapon system, or equipment to perform the missions or functions for which it is organized or designed. It may be used in a general sense to express a level or degree of readiness. (8:493)

In his MS Thesis, titled <u>A Further Examination of Operational Availability in Life Cycle Cost Models</u>, Capt Farnell took it a step further and defined readiness in terms of operational availability. (19:31) Availability, like supportability, is a function of both reliability and maintainability. In its simplest form, as stated by Mr. Calabro, Availability = Reliability + Maintainability. (7:132) This equation obviously does not accurately account for the proper relationship between reliability and maintainability. The purpose of this formula was to only demonstrate that a relationship exists. The following formula taken from <u>Maintainability: A Major Element of System Effectiveness</u> more accurately demonstrates a relationship between availability, reliability, and maintainability (23:67)

$$A = \frac{MTBF}{MTBF + MTTR} \qquad (17)$$

where

A = availability

MTBF = mean time between failure

MTTR = mean time to repair

This formula is a simple, but accurate derivation of availability. In this equation reliability is represented by MTBF, resulting in direct correlation between availability and reliability. The costs associated with the increase in reliability, or more accurately the technology used to achieve the increase, is accounted for in the procurement costs. The problem with using availability came from the difficulty in quantifying the effect of changes on costs. The first step was to determine how availability fit into a life cycle cost analysis.

The definition for operational availability more accurately reflects the relationship involved in weapon systems that are being utilized in the operational world. It was defined as

> The probability that a system or equipment when used under stated conditions and in an actual supply environment shall operate satisfactorily at any given time. (23:26)

Operational availability was mathematically expressed as

$$A_0 = \frac{MTBM}{MTBM + MDT} \qquad (18)$$

where

A_0 = operational availability

MTBM = the mean time between maintenance

MDT = mean downtime, including supply downtime and administrative downtime (5:67)

This formula was found to be effective in measuring system availability but, a problem existed in translating the complexity of calculating avaibility into a more usable form for maintenance managers.

Therefore, the next step was to convert operational availability into a more familiar term. That term was found to be Mission Capable Rates (MCR). In the Air Force, MCR's are used as a measure of the readiness of a weapon system. Much like operational availability, MCR's take into account the effect of the supply environment on the availability of the weapon system. However, the derivation is much less complex. Mission Capable Rates are the result of the ratio of the operable time over the total available time in the period being measured. This ratio can be expressed as follows

$$MCR = \frac{\sum ((AC)*(Time_A - Time_D))}{\sum ((AC)*(Time_A))} \qquad (19)$$

where

MCR = Mission Capable Rate

AC = individual aircraft

$Time_A$ = the total time possessed in a specific time period

$Time_D$ = the total downtime in the specified time period

The MCR is a very important number to any maintenance or wepon system manager. It looms as a very large factor in the supportability of a weapon system.

Another supportability issue to be addressed is the fleet capacity. This is in terms of how many aircraft will it take to perform the mission. Although the C-130 is an established weapon system and the Air Force is not likely to retire any, this issue remains very important.

Calculating the delta of fleet size needed to perform the same mission showed that the main relationship existed between mission flown and mission aborts. In an effort to more clearly demonstrate the relationship, a multi-step procedure was followed.

First, the number of sorties flown was added to the delta in mission aborts attributed to the affected systems. This sum depicts the possible number of sorties to fly.

The next step was to divide the possible number of sorties by the total number of aircraft. This quotient is the possible sortie rate.

The final step entailed dividing the present number of sorties flown by the possible sortie rate. The result is the adjusted total of aircraft needed to perform the same mission. The excess aircraft represents increased lift capability in a world of insufficient lift capability. This procedure is expressed in the following formulas.

$$PSA = (Aborts_A)(PF) + Sorties_P \quad (20)$$

$$Sorties_{NR} = PSA/ACFT_T \quad (21)$$

$$ACFT_{TA} = Sortie_P/Sortie_{NR} \quad (22)$$

where

PSA = the possible number of sorties

$Aborts_A$ = number of aborts attributed to identified avionic systems

$Sorties_{NR}$ = the possible sortie rate per aircraft

$ACFT_T$ = total number of aircraft

$ACFT_{TA}$ = total number of aircraft adjusted

$Sortie_P$ = the present number of completed sorties

Sensitivity Analysis

The effect on reliability in modifying the electrical power system was estimated by experts. In order to evaluate other results, a sensitivity analysis was performed by changing the values given by the experts. This value was referred to in the formulas as (PF). The change in reliability has an effect on the factors such as replenishment spares, repair cost, and second destination costs. The effect on reliability of the identified avionic systems was estimated to increase by three amounts -- 5 percent, 15 percent, and 20 percent of the present reliability performance. Being estimates these numbers can not provide absolute accuracy but can be used to preserve the relative accuracy of the alternatives.

Analysis of Results

Once the cost deltas were determined and the cost model run the results were presented. Evaluation of the input to include shortfalls, assumptions, and strengths was conducted.

Conclusion

This chapter highlighted the process taken to identify the problem and collect the needed data. It then described the process of determining the elements that are held in balance when performing a life cycle analysis--schedule, performance, supportability, and cost.

In describing these elements, it was necessary to develop several formulas for determining the effects of supportability on the life cycle costs.

IV. Analysis of Results

Overview

The objective of this chapter is to report the findings of this research paper. This chapter will start with a discussion of the databases to include weaknesses and strengths. Next, this chapter will report the findings of the cost estimation for both procurement and O&S costs. The final section of this chapter displays the results of the sensitivity analysis performed on relevant O&S cost categories. All findings will be discussed with respect to the methodology used to derive the answers.

Identification of Affected Systems

After an overview of the EPS and the identification of the options, the engineers proceeded to identify the systems most affected. Their first response was any aircraft system/subsystem utilizing electrical power. Further interviews helped to define this as: any system requiring electrical power that employs solid-state circuitry and/or computers. From here, the systems, and associated WUCs, most affected became easy to find. The systems and their descriptions were found in technical order T.O. C-130-A-06. Table 3 is an excerpt of the technical order listing the appropriate systems identified by the engineers. The list of WUCs only utilizes the first two digits because it was only necessary to identify general system categories.

Table 3.
Work Unit Codes and Descriptions of Systems Affected by the EPS

WUC	Description
42	Electrical Power System
51	Instruments, General
52	Autopilot and Compass Systems
61	HF Communication Systems
62	VHF Communication Systems
63	UHF Communication Systems
65	IFF (Identify Friend or Foe)
66	Emergency Communications
69	Miscellaneous Communication Equipment
71	Radio Navigation
72	Radar Navigation

Databases

As mentioned in the methodology section, this research employed multiple databases to satisfy the needs of this analysis. In estimating procurement costs, this did not present a problem. However, in determining the O&S costs problems arose.

The data for procurement costs came from one source. Lockheed Aeronautical Systems Co. acting as the prime contractor assembled the needed data and sent to this researcher. No need to cross reference any other data source arose. Unfortunately, the simplicity of data collection ended here.

Retreiving data for O&S costs appeared simple enough, regrettably, this changed. Many problems inherent in collecting data from multiple sources surfaced. One big problem--the format compatability of the cost and the R&M data bases. The R&M data base stored data monthly by WUCs whereas, the cost data base stored data either in yearly totals by categories or quarterly by WUCs. This incompatibility in format led to the use of the determation of ratios to estimate the costs of needed items.

In collection of the data another problem arose, gaps in the data. In the R&M data base, units minimized reporting from the field during Operation Desert Shield and then Desert Storm. This produced incomplete data. The VAMOSC data base system clearly had gaps. In the automated system only quarters 89-2, 89-3, 90-4, and 91-1 were stored. In addition, the only fiscal year report available was for fiscal year 1989. The data bases used for this research, VAMOSC and MODAS are the only Air Force approved automated data bases accessible for this level of research. Due to these factors, fiscal year 1989 became time frame for data collection. Although most cost data was only available for the second and third quarters of fiscal year 1989, there were summary reports available that supplied some pertinent information.

Procurement Costs

The procurement costs for each alternative are, in essence, contract bids from the respective contractors. The calculations of alternative costs, contained in Appendix D, are summarized in Table 4 . The costs are broken down into two categories non-recurring and recurring costs. Non-recurring costs include research and development (R&D) and initial support. The recurring costs category identifies the per package cost.

Table 4
Proposed Alternatives Costs
(in Millions)

	Alt. 1	Alt. 2	Alt. 3
Non-Recurring Costs			
R&D	$1.550	$5.400	$3.500
Initial Support	$3.765	$2.220	$1.302
Recurring Costs			
Package Price	$0.450	$0.280	$0.160

The initial support listed in the alternatives includes technical publications, support equipment, specialized training, and initial spares.

The next step in the cost estimation was to determine the total cost of the procurement over the life of the program. This meant discounting the future payments to present value figures. The necessity of translating the costs to present value stems from the need to get a clear picture of the total purchase price with respect to the opportunity costs of the money being spent in future years. As mentioned earlier, present value for this research remains fiscal year 1989. One aspect of this analysis that warrants mentioning is the fact that inflation is not figured in to the values derived when using the present value method. Table 5 summarizes calculations for the total procurement costs in present value terms. These calculations are contained in Appendix D. The total recurring costs represents the summation of the present values based on a delivery schedule of 28 packages per year over six years.

Table 5
Present Value of Procurement Costs
(in Millions)

	Alt. 1	Alt. 2	Alt. 3
Non-Recurring Costs			
R&D	$ 1.550	$ 5.400	$ 3.500
Initial Support	$ 3.765	$ 2.220	$ 1.302
Recurring Costs			
Package Price	$62.695	$39.010	$22.290
Total Costs	$68.010	$46.630	$27.092

This table clearly depicts Alternative 3, The Leland Proposal, as having the lowest present value procurement costs. In fact, it more than 40% below the cost of its nearest competitor, Alternative 2. But, this remains as only part of the total costs of the alternatives. Next, the O&S costs must be determined.

Operating & Support Costs

The approach taken by this research was to estimated the relevant costs as opposed to the total O&S costs. The resulting relationship of the alternatives does not change when using this approach. The O&S costs turned out to be the most difficult part of this analysis. Three factors made this a fact (1) noted data problems, (2) having to develop formulas for apparent relationships, and (3) the sensitivity analysis. Tables 6, 7,and 8 show the results of the efforts to estimate O&S costs. In each table there are four columns, Alt. Baseline, 5% Delta, 15% Delta, and 30% Delta.

The Alt. Baseline column shows costs savings of the alternative without consideration of any affects on the identified avionic systems. The remaining three columns estimate costs at three different performance levels of each cost category (based on the engineers estimates of performance deltas). The Delta columns represent the differing levels of performance. These columns consider the affect the EPS has on identified avionic systems. The tables are designed to show the cost savings. Therefore, if a cost increase was realized, instead of a savings, that increase will represented by a negative number. Costs for each category was determined using the formulas derived in Chapter III.

Appendices A, B, and C contain the spreadsheets used for calculating the cost estimations for the relevant logistic cost categories identified in Chapter III as summarized in Tables 6, 7, and 8 respectively.

Table 6
Relevant Logistic Costs for
Alternative 1--IDG System
(in Millions)

Categories	Alt. Baseline	5% Delta	15% Delta	30% Delta
Repair Costs	$(0.0056)	$ 0.3006	$ 0.9129	$ 1.8314
Repl. Spares	$(0.0027)	$ 0.1854	$ 0.5617	$ 1.1261
Cond. Spares	$(0.0009)	$ 0.0329	$ 0.1006	$ 0.2021
Aborts	$(0.0031)	$ 0.0666	$ 0.1997	$ 0.3994
Manpower	$(0.0005)	$ 0.0666	$ 0.2009	$ 0.4023
Trans. Costs	$(0.0030)	$ 0.1725	$ 0.5200	$ 1.0412
Total	$(0.0158)	$ 0.8246	$ 2.4958	$ 5.0025

Table 7
Relevant Logistic Costs for
Alternative 2--VSCF System
(in Millions)

Categories	Alt. Baseline	5% Delta	10% Delta	15% Delta
Repair Costs	$(0.0004)	$ 0.3057	$ 0.9181	$ 1.8365
Repl. Spares	$(0.0002)	$ 0.1879	$ 0.5642	$ 1.1286
Cond. Spares	$(0.0001)	$ 0.0338	$ 0.1014	$ 0.2029
Aborts	$(0.0000)	$ 0.0441	$ 0.1324	$ 0.2648
Manpower	$(0.0000)	$ 0.0671	$ 0.2014	$ 0.4028
Trans. Costs	$(0.0001)	$ 0.1736	$ 0.5211	$ 1.0423
Total	$(0.0008)	$ 0.8122	$ 2.4386	$ 4.8779

Table 8
Relevant Logistic Costs for
Alternative 3--Improved Isolated Generator System
(in Millions)

Categories	Alt. Baseline	5% Delta	10% Delta	15% Delta
Repair Costs	$ 0.0021	$ 0.3083	$ 0.9206	$ 1.8390
Repl. Spares	$ 0.0010	$ 0.1891	$ 0.5654	$ 1.1298
Cond. Spares	$ 0.0009	$ 0.0347	$ 0.1024	$ 0.2039
Aborts	$ 0.0013	$ 0.0755	$ 0.2133	$ 0.4261
Manpower	$ 0.0002	$ 0.0674	$ 0.2016	$ 0.4030
Trans. Costs	$ 0.0005	$ 0.1742	$ 0.5217	$ 1.0429
Total	$ 0.0060	$ 0.8492	$ 2.5250	$ 5.0447

In each case, although very slight, Alternative 3 reports the largest overall cost savings. One interesting fact is that even if there is zero effect on the identified avionic systems systems (Alt Baselines) only alternative three actually realizes a present value cost savings. This is largely due to the fact that the EPS system itself does not increase costs in any category. Further analysis of these results included determining the savings over the years. First, it was necessary to determine the cost savings for the first six years when only a percentage of the aircraft have been modified. Next, all future cost savings, like the procurement costs, must be translated into present value.

The logical next step was to compare the procurement costs and the logistic cost savings over the years, using the present value methodology, to show the feasibility of each option in terms of the total dollar expenditure. The results of this analysis are shown in Table 9.

Table 9
Total Cost of Alternatives
(in Millions)

	Discounted Procurement Costs	Discounted O&S Cost Savings	Discounted Total Cost
Alternative 1	$ 68.01	$ 5.841	$ 62.169
Alternative 2	$ 46.63	$ 5.748	$ 40.882
Alternative 3	$ 27.09	$ 6.007	$ 21.083

Because the purpose of this table was to show the total effect of the selection of each alternative, only the performance delta of 5 percent was used. Obviously, if the higher deltas were used the cost savings would be greater. As seen, Alternative 3 again shows the largest cost savings over the life of the program. The larger O&S cost savings is due to the larger yearly savings. In addition, the total cost of the system net the O&S cost savings shows Alternative 3, The Leland Proposal, to be the lowest cost alternative. Because of this Alternative 3 became even more attractive.

Supportability Issues

The last item discussed in the methodology section considered supportability issues. The two main issues addressed were the possible change in mission capable rates and fleet size or fleet capacity. These costs to the Air Force were quantified but not in dollars. That does not make them any less important. In fact, a combat commander would be more interested in these two factors than how much it cost to modify the airplane.

The first factor to evaluate is the mission capable rates (MCR). This factor was elusive in trying to quantify. The interrelationship between fully mission capable rates, partly mission capable rates and time were not found. However, to get an understanding of the direction of impact, the delta in total maintenance manhours was used. The MCR was calculated as a function of the aircraft available time divided by the possessed time in a specific time period. As with the total costs, MCR was calculated using the performance delta of 5 percent. Table 10 shows the results of the analysis. In this table, Baseline indicates the current C-130 MCR.

Table 10
Mission Capable Rates of Alternatives

Baseline	Alt 1	Alt 2	Alt 3
73.65%	73.679%	73.6804%	73.6806%

Without all variables, especially the impact of supply, it is hard to determine the real effect. However, it is interesting to note that MCR only changed approximately .03% for all alternatives. This is not a noteworthy change.

The remaining issue is the fleet size or capacity. The fleet size was calculated by determining the possible sortie rate after adjusting for the number of aborts attributed to the identified avionic systems. Then dividing the present number of sorties by the possible sortie rate. This yields the number of aircraft needed to accomplish the same mission presently being accomplished. The results of this analysis are contained in Table 11.

Table 11
Fleet Size Needed of Alternatives
to Perform the Same Mission

Baseline	Alt 1	Alt 2	Alt 3
168	167.982	167.981	167.9807

As with the previous supportability issue, all the factors--specifically supply, are needed to get a more accurate accounting of the new EPS's effect. Again, the delta between alternatives is miniscule. To show a difference, Alternative 3 had to be taken out the fourth decimal place.

With the available data and knowledge of the researcher, the supportability issues do not bring much to bear on the choice between alternatives.

V. Conclusions and Recommendations

Conclusions

This research has presented all the factors needed to answer the research question submitted in Chapter I. The answer to the question which Alternative best balances the factors of a life cycle cost analysis is Alternative 3.

The schedule remained unchanged for each alternative. All three alternatives would follow the 28 packages per year delivery schedule. Performance measures, the supply of clean, constant power to loads can be accomplished by all three alternatives. By implementing one of these options the specifications set forth in MIL-STD-704 will be met. These two areas is where the equality of the alternatives ends.

Although slight, the supportability issues discussed in Chapters III & IV pointed to Alternative 3 being a better option for the logistics and operations troops. Supportability findings were incomplete because of the lack of information on the impact supply would have on the MCR and capacity of the C-130. If the trend of improvement holds with the incorporation of supply effects the deltas in MCR and capacity would further favor Alternative 3. The results of the increase in these areas would increase the lift capacity of the C-130 thus, enhancing intra-theater operations. In times of crisis, such as Desert Storm, this would be a critical factor in the survivability factor or allied troops.

All of the factors involved in this analysis had some influence on every other factor. The supportability factors were affected by the relevant logistic categories which in turn affected the overall cost of the program. After analysis of the procurement and O&S costs, it became clear that Alternative 3 possessed the lowest overall cost. In fact, after the costs were discounted using the present value methodology, as directed by Air Force regulations, Alternative 3 became even more attractive. Looking at the alternatives without showing any effect on the avionic/communication equipment also proved Alternative 3 the most cost effective.

The technology and performance of Alternatives 1 and 2 are outstanding and in other aircraft prove very cost effective. However, the incorporation of these systems in other aircraft were from inception. When done in that fashion a 'system' approach can extract all the benefits the more advanced EPS systems proposed in Alternatives 1 and 2. Unfortunately, trying to incorporate the same technology in the C-130 proved to expensive. In comparison, it became evident that the simplicity of design and ease of modification for Alternative 3 made it far and away the only choice to make.

Recommendations

The recommendations presented here are based on the processes utilized, conclusions drawn, and any pitfalls encountered during this research project.

The first recommendation is that the Leland proposal be approved and the project started in the next fiscal period possible. Incorporation of this alternative will result in the C-130 meeting power requirements set forth in MIL-STD-704B. By doing this, the Air Force will meeting its responsibility of supplying safe, reliable aircraft to its aircrews.

The cost incorporating this alternative is not prohibitive. As shown in the analysis, the total cost including all associated savings is approximately $21 million for 168 aircraft. This figure does not include savings in depot costs, support equipment and possible manpower reductions that could be realized.

Secondly, the concepts and objectives of the VAMOSC system are valid and to a point the system is performing in the manner in which was designed to do. However, the operational commands must take better care in supplying complete and accurate data. If this were done the gaps in data that currently exist would slowly diminish. In addition, analysis' could be done in a more current year which would shed better light on the real costs involved.

Third, supply, R&M, and cost data bases must be more compatible. During this research many discrepancies were found between data bases that could have a bearing on the analysis. One such difference was the total flying hours over the same period of time. Another difficulty was trying to translate needs from the costs data base to a supply data base. Because the two data bases do not talk to each other it was most difficult to get needed data. To get the data would have been expensive and time consuming.

Lastly, the cost center is filled with people that bent over backwards to help when called upon but, a lot of their valuable time could have been saved if a centralized data base were available. The feasibility of incorporating many of the data bases and developing an MIS that would allow for easier access and cross-referencing.

Recommendation for Further Research

Further research in the area of Air Force data bases and their compatability is needed. Other studies and research projects could be greatly enhanced through the use of complete and accurate data bases. In addition, research in the field of the usefulness of LCC models is needed.

This research investigated three alternatives to a proposed electrical power system modification to the C-130 aircraft. A cost analysis approach based on analogies was utilized. Conclusions drawn on the analysis presented Alternative 3, from Leland as both the most cost effective and supportable.

Appendix A: Data Used for Supportability Formulas

Yearly flying hours (FY 89) = 117,421

Quarterly flying hours (89-2) = 28,769

Quarterly Sorties (89-2) = 12,899

Number of Total Aircraft Aborts = 942

Number of Aborts attributed to affected systems = 178

Current Mission Capable Rate = 73.65

Appendix B: Spreadsheets for Procurement Costs

ALTERNATIVE 1 -- SUNDSTRAND SYSTEM

YRLY SAVINGS $0.6462

TOTAL COST = $63.6052

	FACT	R&D COST	PROCUREMENT COSTS	O&S COSTS SAVINGS	PV COST SAVINGS	TOTAL COSTS
YR0	1.0000	$5.32	$12.60	$0.00		$17.81
YR1	0.9535		$12.01	$0.11	($0.1027)	$11.91
YR2	0.8668		$10.92	$0.22	($0.1867)	$10.73
YR3	0.7880		$9.93	$0.32	($0.2546)	$9.67
YR4	0.7154		$9.03	$0.43	($0.3086)	$8.72
YR5	0.6512		$8.21	$0.54	($0.3507)	$7.85
YR6	0.5920			$0.65	($0.3826)	($0.38)
YR7	0.5382			$0.65	($0.3478)	($0.35)
YR8	0.4893			$0.65	($0.3162)	($0.32)
YR9	0.4448			$0.65	($0.2874)	($0.29)
YR10	0.4044			$0.65	($0.2613)	($0.26)
YR11	0.3676			$0.65	($0.2375)	($0.24)
YR12	0.3342			$0.65	($0.2160)	($0.22)
YR13	0.3038			$0.65	($0.1963)	($0.20)
YR14	0.2762			$0.65	($0.1785)	($0.18)
YR15	0.2511			$0.65	($0.1623)	($0.16)
YR16	0.2283			$0.65	($0.1475)	($0.15)
YR17	0.2075			$0.65	($0.1341)	($0.13)
YR18	0.1886			$0.65	($0.1219)	($0.12)
YR19	0.1715			$0.65	($0.1108)	($0.11)
YR20	0.1559			$0.65	($0.1007)	($0.10)
YR25	0.0968			$0.65	($0.0626)	($0.06)
TOTALS		$5.32	$62.70	$11.31	($4.3034)	$63.6052

ALTERNATIVE 2 – WESTINGHOUSE SYSTEM

YRLY SAVINGS $0.6886

TOTAL COST = $41.9305

	FACT	R&D COST	PROCUREMENT COSTS	O&S COSTS SAVINGS	PV COST SAVINGS	TOTAL COSTS
YR0	1.0000	$7.62	$7.34	$0.00		$15.35
YR1	0.9535		$7.48	$0.11	($0.1094)	$7.37
YR2	0.8668		$6.80	$0.23	($0.1990)	$6.60
YR3	0.7880		$6.18	$0.34	($0.2713)	$5.91
YR4	0.7164		$5.62	$0.46	($0.3289)	$5.29
YR5	0.6512		$5.11	$0.57	($0.3737)	$4.73
YR6	0.5920			$0.69	($0.4077)	($0.41)
YR7	0.5382			$0.69	($0.3706)	($0.37)
YR8	0.4893			$0.69	($0.3369)	($0.34)
YR9	0.4448			$0.69	($0.3063)	($0.31)
YR10	0.4044			$0.69	($0.2785)	($0.28)
YR11	0.3676			$0.69	($0.2531)	($0.25)
YR12	0.3342			$0.69	($0.2301)	($0.23)
YR13	0.3038			$0.69	($0.2092)	($0.21)
YR14	0.2762			$0.69	($0.1902)	($0.19)
YR15	0.2511			$0.69	($0.1729)	($0.17)
YR16	0.2283			$0.69	($0.1572)	($0.16)
YR17	0.2075			$0.69	($0.1429)	($0.14)
YR18	0.1886			$0.69	($0.1299)	($0.13)
YR19	0.1715			$0.69	($0.1181)	($0.12)
YR20	0.1559			$0.69	($0.1074)	($0.11)
YR25	0.0968			$0.69	($0.0667)	($0.07)
TOTALS		$7.62	$39.01	$12.05	($4.5858)	$41.9305

ALTERNATIVE 3 -- LELAND SYSTEM

YRLY SAVINGS
$0.9141

TOTAL COST = $20.8541

	FACT	R&D COST	PROCUREMENT COSTS	O&S COSTS SAVINGS	PV COST SAVINGS	TOTAL COSTS
YR0	1.0000	$4.80	$4.48	$0.00		$9.13
YR1	0.9535		$4.27	$0.15	($0.1453)	$4.13
YR2	0.8668		$3.88	$0.30	($0.2641)	$3.62
YR3	0.7880		$3.53	$0.46	($0.3602)	$3.17
YR4	0.7164		$3.21	$0.61	($0.4366)	$2.77
YR5	0.6512		$2.92	$0.76	($0.4961)	$2.42
YR6	0.5920			$0.91	($0.5411)	($0.54)
YR7	0.5382			$0.91	($0.4920)	($0.49)
YR8	0.4893			$0.91	($0.4473)	($0.45)
YR9	0.4448			$0.91	($0.4066)	($0.41)
YR10	0.4044			$0.91	($0.3697)	($0.37)
YR11	0.3676			$0.91	($0.3360)	($0.34)
YR12	0.3342			$0.91	($0.3055)	($0.31)
YR13	0.3038			$0.91	($0.2777)	($0.28)
YR14	0.2762			$0.91	($0.2525)	($0.25)
YR15	0.2511			$0.91	($0.2295)	($0.23)
YR16	0.2283			$0.91	($0.2087)	($0.21)
YR17	0.2075			$0.91	($0.1897)	($0.19)
YR18	0.1886			$0.91	($0.1724)	($0.17)
YR19	0.1715			$0.91	($0.1568)	($0.16)
YR20	0.1559			$0.91	($0.1425)	($0.14)
YR25	0.0968			$0.91	($0.0885)	($0.09)
TOTALS		$4.80	$22.29	$16.00	($6.0876)	$20.8541

Appendix C: Spreadsheets for the Sundstrand Proposal

COST OF MISSION ABORTS
FOR THE SUNDSTRAND PROPOSAL
(in Millions)

Baseline FH Costs =		$393.800	Flying Hours =		117,421	
			Sorties =		52648	
FACTOR	0.05		Cost/Sortie =		$0.0075	
	=====					

SYSTEM	NO. OF ABORTS	COST OF ABORTS	ADJUSTED NO. OF ABORTS	DELTA	ADJUSTED COST OF DELTA	COST SAVINGS
42XXX	60	$0.4488	61.42	-1.42	$0.4594	($0.0107)
51XXX	29	$0.2169	27.55	1.45	$0.2061	$0.0108
52XXX	21	$0.1571	19.95	1.05	$0.1492	$0.0079
61XXX	3	$0.0224	2.85	0.15	$0.0213	$0.0011
62XXX	6	$0.0449	5.70	0.30	$0.0426	$0.0022
63XXX	1	$0.0075	0.95	0.05	$0.0071	$0.0004
65XXX	6	$0.0449	5.70	0.30	$0.0426	$0.0022
66XXX	0	$0.0000	0.00	0.00	$0.0000	$0.0000
69XXX	0	$0.0000	0.00	0.00	$0.0000	$0.0000
71XXX	4	$0.0299	3.80	0.20	$0.0284	$0.0015
72XXX	48	$0.3590	45.60	2.40	$0.3411	$0.0180
Total	178	$1.3314	173.524	4.476	$1.2979	$0.0335

TOTAL COST SAVINGS FOR CHANGE IN ABORTS IS $0.0335

COST OF MISSION ABORTS
FOR THE SUNDSTRAND PROPOSAL
(in Millions)

Baseline FH Costs =		$393.800	Flying Hours =	117,421
			Sorties =	52646
FACTOR	0.15		Cost/Sortie =	$0.0075

SYSTEM	NO. OF ABORTS	COST OF ABORTS	ADJUSTED NO. OF ABORTS	DELTA	ADJUSTED COST OF DELTA	COST SAVINGS
42XXX	60	$0.4488	61.42	-1.42	$0.4594	($0.0107)
51XXX	29	$0.2169	24.65	4.35	$0.1844	$0.0325
52XXX	21	$0.1571	17.85	3.15	$0.1335	$0.0236
61XXX	3	$0.0224	2.55	0.45	$0.0191	$0.0034
62XXX	6	$0.0449	5.10	0.90	$0.0381	$0.0067
63XXX	1	$0.0075	0.85	0.15	$0.0064	$0.0011
65XXX	6	$0.0449	5.10	0.90	$0.0381	$0.0067
66XXX	0	$0.0000	0.00	0.00	$0.0000	$0.0000
69XXX	0	$0.0000	0.00	0.00	$0.0000	$0.0000
71XXX	4	$0.0299	3.40	0.60	$0.0254	$0.0045
72XXX	48	$0.3590	40.80	7.20	$0.3052	$0.0539
Total	178	$1.3314	161.724	16.276	$1.2097	$0.1217

TOTAL COST SAVINGS FOR CHANGE IN ABORTS IS $0.1217

COST OF MISSION ABORTS
FOR THE SUNDSTRAND PROPOSAL
(in Millions)

Baseline FH Costs = $393.800 | Flying Hours = 117,421
Sorties = 52548
FACTOR 0.3 | Cost/Sortie = $0.0075

SYSTEM	NO. OF ABORTS	COST OF ABORTS	ADJUSTED NO. OF ABORTS	DELTA	ADJUSTED COST OF DELTA	COST SAVINGS
42XXX	60	$0.4488	61.42	-1.42	$0.4594	($0.0107)
51XXX	29	$0.2169	20.30	8.70	$0.1518	$0.0651
52XXX	21	$0.1571	14.70	6.30	$0.1100	$0.0471
61XXX	3	$0.0224	2.10	0.90	$0.0157	$0.0067
62XXX	6	$0.0449	4.20	1.80	$0.0314	$0.0135
63XXX	1	$0.0075	0.70	0.30	$0.0052	$0.0022
65XXX	6	$0.0449	4.20	1.80	$0.0314	$0.0135
66XXX	0	$0.0000	0.00	0.00	$0.0000	$0.0000
69XXX	0	$0.0000	0.00	0.00	$0.0000	$0.0000
71XXX	4	$0.0299	2.80	1.20	$0.0209	$0.0090
72XXX	48	$0.3590	33.60	14.40	$0.2513	$0.1077
Total	178	$1.3314	144.024	33.976	$1.0773	$0.2541

TOTAL COST SAVINGS FOR CHANGE IN ABORTS IS $0.2541

COSTS OF REPLENISHMENT SPARES
FOR THE SUNDSTRAND PROPOSAL
(in Millions)

BASELINE TOTAL REPLENISHMENT SPARES COST = 13.814 (in millions)

FACTOR 0.05

SYSTEM	REMOVALS	% OF TOTAL	COST OF SPARES	ADJUSTED REMOVALS	SAVINGS COST	ADJUSTED COST OF SPARES
42XXX	1603	0.0244	$0.3371	39.41	($0.0084)	$0.3455
51XXX	2358	0.0359	$0.4959	2240.10	$0.0248	$0.4711
52XXX	2345	0.0357	$0.4932	2227.75	$0.0247	$0.4685
61XXX	617	0.0094	$0.1298	586.15	$0.0065	$0.1233
62XXX	427	0.0065	$0.0898	405.65	$0.0045	$0.0853
63XXX	499	0.0076	$0.1049	474.05	$0.0052	$0.0997
65XXX	525	0.0080	$0.1104	498.75	$0.0055	$0.1049
66XXX	296	0.0045	$0.0623	281.20	$0.0031	$0.0591
69XXX	72	0.0011	$0.0151	68.40	$0.0008	$0.0144
71XXX	2194	0.0334	$0.4614	2084.30	$0.0231	$0.4384
72XXX	8558	0.1303	$1.7999	8130.10	$0.0900	$1.7099
TOTAL	19494	0.2968	$4.0998	17035.86	$0.1798	$3.9201
MDS TOTA	65683					

TOTAL SAVINGS FOR REPLENISHMENT SPARES = $0.1798

COSTS OF REPLENISHMENT SPARES
FOR THE SUNDSTRAND PROPOSAL
(in Millions)

BASELINE TOTAL REPLENISHMENT SPARES COST = 13.814 (in millions)

FACTOR 0.15

SYSTEM	REMOVALS	% OF TOTAL	COST OF SPARES	ADJUSTED REMOVALS	SAVINGS COST	ADJUSTED COST OF SPARES
42XXX	1603	0.0244	$0.3371	39.41	($0.0084)	$0.3455
51XXX	2358	0.0359	$0.4959	2004.30	$0.0744	$0.4215
52XXX	2345	0.0357	$0.4932	1993.25	$0.0740	$0.4192
61XXX	617	0.0094	$0.1298	524.45	$0.0195	$0.1103
62XXX	427	0.0065	$0.0898	362.95	$0.0135	$0.0763
63XXX	499	0.0076	$0.1049	424.15	$0.0157	$0.0892
65XXX	525	0.0080	$0.1104	446.25	$0.0166	$0.0939
66XXX	296	0.0045	$0.0625	251.60	$0.0093	$0.0529
69XXX	72	0.0011	$0.0151	61.20	$0.0023	$0.0129
71XXX	2194	0.0334	$0.4614	1864.90	$0.0692	$0.3922
72XXX	8558	0.1303	$1.7999	7274.30	$0.2700	$1.5299
TOTAL	19494	0.2968	$4.0998	15246.76	$0.5560	$3.5438
MDS TOTA	65683					

TOTAL SAVINGS FOR REPLENISHMENT SPARES = $0.5560

COSTS OF REPLENISHMENT SPARES
FOR THE SUNDSTRAND PROPOSAL
(in Millions)

BASELINE TOTAL REPLENISHMENT SPARES COST = 13.814 (in millions)

FACTOR 0.3

SYSTEM	REMOVALS	% OF TOTAL	COST OF SPARES	ADJUSTED REMOVALS	SAVINGS COST	ADJUSTED COST OF SPARES
42XXX	1603	0.0244	$0.3371	39.41	($0.0084)	$0.3455
51XXX	2358	0.0359	$0.4959	1650.60	$0.1488	$0.3471
52XXX	2345	0.0357	$0.4932	1641.50	$0.1480	$0.3452
61XXX	617	0.0094	$0.1298	431.90	$0.0389	$0.0908
62XXX	427	0.0065	$0.0898	298.90	$0.0269	$0.0629
63XXX	499	0.0076	$0.1049	349.30	$0.0315	$0.0735
65XXX	525	0.0080	$0.1104	367.50	$0.0331	$0.0773
66XXX	296	0.0045	$0.0623	207.20	$0.0187	$0.0436
69XXX	72	0.0011	$0.0151	50.40	$0.0045	$0.0106
71XXX	2194	0.0334	$0.4614	1535.80	$0.1384	$0.3230
72XXX	8558	0.1303	$1.7999	5990.60	$0.5400	$1.2599
TOTAL	19494	0.2968	$4.0998	12563.11	$1.1205	$2.9794
MDS TOTA	65683					

TOTAL SAVINGS FOR REPLENISHMENT SPARES = $1.1205

COSTS OF CONDEMNATION SPARES
FOR THE SUNDSTRAND PROPOSAL
(in Millions)

MDS TOTAL CONDEMNATION SPARES COST = $2.3155

FACTOR = 0.05

SYSTEM	COND. ITEMS	% OF TOTAL	COST OF COND. ITEMS	ADJUSTED COND. ITEMS	ADJUSTED COST	COST SAVINGS
42XXX	33	0.0485	$0.1122	5.45	$0.1307	($0.0185)
51XXX	9	0.0132	$0.0306	6.30	$0.0291	$0.0015
52XXX	15	0.0220	$0.0510	10.50	$0.0485	$0.0026
61XXX	22	0.0323	$0.0748	15.40	$0.0711	$0.0037
62XXX	4	0.0059	$0.0136	2.80	$0.0129	$0.0007
63XXX	2	0.0029	$0.0068	1.40	$0.0065	$0.0003
65XXX	3	0.0044	$0.0102	2.10	$0.0097	$0.0005
66XXX	12	0.0176	$0.0408	8.40	$0.0388	$0.0020
69XXX	30	0.0441	$0.1020	21.00	$0.0969	$0.0051
71XXX	32	0.0470	$0.1088	22.40	$0.1034	$0.0054
72XXX	70	0.1028	$0.2380	49.00	$0.2261	$0.0119
TOTAL	232	0.3407	$0.7888	144.75	$0.7735	$0.0153
MDS TOTAL	681					

COST SAVINGS ATTRIBUTED TO CONDEMNATION SPARES = $0.0153

COSTS OF CONDEMNATION SPARES
FOR THE SUNDSTRAND PROPOSAL
(in Millions)

MDS TOTAL CONDEMNATION SPARES COST = $2.3155

FACTOR = 0.15

=====

SYSTEM	COND. ITEMS	% OF TOTAL	COST OF COND. ITEMS	ADJUSTED COND. ITEMS	ADJUSTED COST	COST SAVINGS
42XXX	33	0.0485	$0.1122	5.45	$0.1307	($0.0185)
51XXX	9	0.0132	$0.0306	6.30	$0.0260	$0.0046
52XXX	15	0.0220	$0.0510	10.50	$0.0434	$0.0077
61XXX	22	0.0323	$0.0748	15.40	$0.0636	$0.0112
62XXX	4	0.0059	$0.0136	2.80	$0.0116	$0.0020
63XXX	2	0.0029	$0.0068	1.40	$0.0058	$0.0010
65XXX	3	0.0044	$0.0102	2.10	$0.0087	$0.0015
66XXX	12	0.0176	$0.0408	8.40	$0.0347	$0.0061
69XXX	30	0.0441	$0.1020	21.00	$0.0867	$0.0153
71XXX	32	0.0470	$0.1088	22.40	$0.0925	$0.0163
72XXX	70	0.1028	$0.2380	49.00	$0.2023	$0.0357
TOTAL	232	0.3407	$0.7868	144.75	$0.7059	$0.0830
MDS TOTAL	681					

COST SAVINGS ATTRIBUTED TO CONDEMNATION SPARES = $0.0830

COSTS OF CONDEMNATION SPARES FOR THE SUNDSTRAND PROPOSAL (in Millions)

MDS TOTAL CONDEMNATION SPARES COST = $2.3155

FACTOR = 0.3

SYSTEM	===== COND. ITEMS	% OF TOTAL	COST OF COND. ITEMS	ADJUSTED COND. ITEMS	ADJUSTED COST	COST SAVINGS
42XXX	33	0.0485	$0.1122	5.45	$0.1307	($0.0185)
51XXX	9	0.0132	$0.0306	6.30	$0.0214	$0.0092
52XXX	15	0.0220	$0.0510	10.50	$0.0357	$0.0153
61XXX	22	0.0323	$0.0748	15.40	$0.0524	$0.0224
62XXX	4	0.0059	$0.0136	2.80	$0.0095	$0.0041
63XXX	2	0.0029	$0.0068	1.40	$0.0048	$0.0020
65XXX	3	0.0044	$0.0102	2.10	$0.0071	$0.0031
66XXX	12	0.0176	$0.0408	8.40	$0.0286	$0.0122
69XXX	30	0.0441	$0.1020	21.00	$0.0714	$0.0306
71XXX	32	0.0470	$0.1088	22.40	$0.0762	$0.0326
72XXX	70	0.1028	$0.2380	49.00	$0.1666	$0.0714
TOTAL	232	0.3407	$0.7888	144.75	$0.6044	$0.1845
MDS TOTAL	681					

COST SAVINGS ATTRIBUTED TO CONDEMNATION SPARES = $0.1845

COSTS OF REPAIR COSTS
FOR THE SUNDSTRAND PROPOSAL
(in Millions)

MDS TOTAL REPAIR COST = $6.8207

FACTOR = 0.05

=====

ADJUSTED COST OF COND. ITEMS	SYSTEM	REPAIR COSTS	% OF TOTAL	ADJUSTED REPAIR COSTS	SAVINGS COST
$0.1131	42XXX	$0.6975	0.1023	$0.7521	($0.0546)
$0.0291	51XXX	$0.9136	0.1339	$0.8679	$0.0457
$0.0485	52XXX	$1.5399	0.2258	$1.4629	$0.0770
$0.0711	61XXX	$0.1524	0.0223	$0.1448	$0.0076
$0.0129	62XXX	$0.0721	0.0106	$0.0685	$0.0036
$0.0065	63XXX	$0.0650	0.0095	$0.0618	$0.0033
$0.0097	65XXX	$0.0740	0.0108	$0.0703	$0.0037
$0.0388	66XXX	$0.0053	0.0008	$0.0050	$0.0003
$0.0969	69XXX	$0.0030	0.0004	$0.0029	$0.0002
$0.1034	71XXX	$0.2955	0.0433	$0.2807	$0.0148
$0.2261	72XXX	$3.0024	0.4402	$2.8523	$0.1501
$0.7559	TOTAL	$6.8207	1.0000	$6.5691	$0.2516

THE REPAIR COST SAVINGS = $0.2516

COSTS OF REPAIR COSTS
FOR THE SUNDSTRAND PROPOSAL
(in Millions)

MDS TOTAL REPAIR COST = $6.8207

FACTOR = 0.3

=====

ADJUSTED COST OF COND. ITEMS	SYSTEM	REPAIR COSTS	% OF TOTAL	ADJUSTED REPAIR COSTS	SAVINGS COST
$0.1131	42XXX	$0.6975	0.1023	$0.7521	($0.0546)
$0.0291	51XXX	$0.9136	0.1339	$0.6395	$0.2741
$0.0485	52XXX	$1.5399	0.2258	$1.0779	$0.4620
$0.0711	61XXX	$0.1524	0.0223	$0.1067	$0.0457
$0.0129	62XXX	$0.0721	0.0106	$0.0505	$0.0216
$0.0065	63XXX	$0.0650	0.0095	$0.0455	$0.0195
$0.0097	65XXX	$0.0740	0.0108	$0.0518	$0.0222
$0.0388	66XXX	$0.0053	0.0008	$0.0037	$0.0016
$0.0969	69XXX	$0.0030	0.0004	$0.0021	$0.0009
$0.1034	71XXX	$0.2955	0.0433	$0.2068	$0.0886
$0.2261	72XXX	$3.0024	0.4402	$2.1017	$0.9007
$0.7559	TOTAL	$6.8207	1.0000	$5.0383	$1.7824

THE REPAIR COST SAVINGS = $1.7824

COSTS OF REPAIR COSTS
FOR THE SUNDSTRAND PROPOSAL
(in Millions)

MDS TOTAL REPAIR COST = $6.8207
FACTOR = 0.15
=====

ADJUSTED COST OF COND. ITEMS	SYSTEM	REPAIR COSTS	% OF TOTAL	ADJUSTED REPAIR COSTS	SAVINGS COST
$0.1131	42XXX	$0.6975	0.1023	$0.7521	($0.0546)
$0.0291	51XXX	$0.9136	0.1339	$0.7766	$0.1370
$0.0485	52XXX	$1.5399	0.2258	$1.3089	$0.2310
$0.0711	61XXX	$0.1524	0.0223	$0.1295	$0.0229
$0.0129	62XXX	$0.0721	0.0106	$0.0613	$0.0108
$0.0065	63XXX	$0.0650	0.0095	$0.0553	$0.0098
$0.0097	65XXX	$0.0740	0.0108	$0.0629	$0.0111
$0.0388	66XXX	$0.0053	0.0008	$0.0045	$0.0008
$0.0969	69XXX	$0.0030	0.0004	$0.0026	$0.0005
$0.1034	71XXX	$0.2955	0.0433	$0.2511	$0.0443
$0.2261	72XXX	$3.0024	0.4402	$2.5521	$0.4504
$0.7559	TOTAL	$6.8207	1.0000	$5.9568	$0.8639

THE REPAIR COST SAVINGS = $0.8639

2nd DESTINATION TRANSPORTATION COSTS
FOR THE SUNDSTRAND PROPOSAL
(in Millions)

MDS TOTAL 2nd DEST. TRANSPORTATION COST = $3.6306

FACTOR 0.05

SYSTEM	===== NUMBER OF NRTS ITEMS	NUMBER NRTS AND CONDEMNED ITEMS	TRANS. COSTS	ADJUSTED NUMBER OF NRTS ITEMS	ADJUSTED TRANS. COSTS OF NRTS ITEMS	SAVINGS COST
42XXX	162	195.00	$0.1559	261.792	$0.2093	($0.0534)
51XXX	916	925.00	$0.7394	878.750	$0.7024	$0.0370
52XXX	1109	1124.00	$0.8984	1067.800	$0.8535	$0.0449
61XXX	132	154.00	$0.1231	146.300	$0.1169	$0.0062
62XXX	135	139.00	$0.1111	132.050	$0.1056	$0.0056
63XXX	115	117.00	$0.0935	111.150	$0.0888	$0.0047
65XXX	173	176.00	$0.1407	167.200	$0.1336	$0.0070
66XXX	10	22.00	$0.0176	20.900	$0.0167	$0.0009
69XXX	5	35.00	$0.0280	33.250	$0.0266	$0.0014
71XXX	374	406.00	$0.3245	385.700	$0.3083	$0.0162
72XXX	1179	1249.00	$0.9984	1186.550	$0.9484	$0.0499
TOTAL	4310	4542.00	$3.6306	4391.442	$3.5102	$0.1203
MDS TOT	7668					

2nd DESTINATION TRANSPORTATION COST SAVINGS = $0.1203

2nd DESTINATION TRANSPORTATION COSTS
FOR THE SUNDSTRAND PROPOSAL
(in Millions)

MDS TOTAL 2nd DEST. TRANSPORTATION COST = $3.6306
FACTOR 0.15

SYSTEM	NUMBER OF NRTS ITEMS	NUMBER NRTS AND CONDEMNED ITEMS	TRANS. COSTS	ADJUSTED NUMBER OF NRTS ITEMS	ADJUSTED TRANS. COSTS OF NRTS ITEMS	SAVINGS COST
42XXX	162	195.00	$0.1559	261.792	$0.2093	($0.0534)
51XXX	916	925.00	$0.7394	786.250	$0.6285	$0.1109
52XXX	1109	1124.00	$0.8984	955.400	$0.7637	$0.1348
61XXX	132	154.00	$0.1231	130.900	$0.1046	$0.0185
62XXX	135	139.00	$0.1111	118.150	$0.0944	$0.0167
63XXX	115	117.00	$0.0935	99.450	$0.0795	$0.0140
65XXX	173	176.00	$0.1407	149.600	$0.1196	$0.0211
66XXX	10	22.00	$0.0176	18.700	$0.0149	$0.0026
69XXX	5	35.00	$0.0280	29.750	$0.0238	$0.0042
71XXX	374	406.00	$0.3245	345.100	$0.2758	$0.0487
72XXX	1179	1249.00	$0.9984	1061.650	$0.8486	$0.1498
TOTAL	4310	4542.00	$3.6306	3956.742	$3.1627	$0.4678
MDS TOT	7668					

2nd DESTINATION TRANSPORTATION COST SAVINGS = $0.4678

2nd DESTINATION TRANSPORTATION COSTS
FOR THE SUNDSTRAND PROPOSAL
(in Millions)

MDS TOTAL 2nd DEST. TRANSPORTATION COST = $3.6306

FACTOR 0.3

SYSTEM	===== NUMBER OF NRTS ITEMS	NUMBER NRTS AND CONDEMNED ITEMS	TRANS. COSTS	ADJUSTED NUMBER OF NRTS ITEMS	ADJUSTED TRANS. COSTS OF NRTS ITEMS	SAVINGS COST
42XXX	162	195.00	$0.1559	261.792	$0.2093	($0.0534)
51XXX	916	925.00	$0.7394	647.500	$0.5176	$0.2218
52XXX	1109	1124.00	$0.8984	786.800	$0.6289	$0.2695
61XXX	132	154.00	$0.1231	107.800	$0.0862	$0.0369
62XXX	135	139.00	$0.1111	97.300	$0.0778	$0.0333
63XXX	115	117.00	$0.0935	81.900	$0.0655	$0.0281
65XXX	173	176.00	$0.1407	123.200	$0.0985	$0.0422
66XXX	10	22.00	$0.0176	15.400	$0.0123	$0.0053
69XXX	5	35.00	$0.0280	24.500	$0.0196	$0.0084
71XXX	374	406.00	$0.3245	284.200	$0.2272	$0.0974
72XXX	1179	1249.00	$0.9984	874.300	$0.6989	$0.2995
TOTAL	4310	4542.00	$3.6306	3304.692	$2.6415	$0.9890
MDS TOT	7668					

2nd DESTINATION TRANSPORTATION COST SAVINGS = $0.9890

COST OF BASE LEVEL MAINTENANCE MANHOURS
FOR THE SUNDSTRAND PROPOSAL
(in Millions)

TOTAL BASE LEVEL MAINTENANCE COSTS =	$49.52
ADJUSTED BASE LEVEL MAINTENANCE COSTS =	$49.47
TOTAL MANHOUR COST SAVINGS =	$0.0457

FACTOR 0.05
============

SYSTEM	REMOVALS	ADJUSTED REMOVALS	DELTA	MMHTR	LABOR COST	MAINTENANCE MANHOURS COST SAVINGS
42XXX	1603	2128.46	-525.46	3.5	11.68	($0.0215)
51XXX	2358	2240.10	117.90	5.4	11.68	$0.0074
52XXX	2345	2227.75	117.25	7.4	11.68	$0.0101
61XXX	617	586.15	30.85	5.5	11.68	$0.0020
62XXX	427	405.65	21.35	5.1	11.68	$0.0013
63XXX	499	474.05	24.95	5.4	11.68	$0.0016
65XXX	525	498.75	26.25	6.0	11.68	$0.0018
66XXX	296	281.20	14.80	3.7	11.68	$0.0006
69XXX	72	68.40	3.60	7.5	11.68	$0.0003
71XXX	2194	2084.30	109.70	6.6	11.68	$0.0085
72XXX	8558	8130.10	427.90	6.7	11.68	$0.0335
TOTAL	19,494	19,125	369.09			$0.0457
MDS TOTAL	65,683					

COST OF BASE LEVEL MAINTENANCE MANHOURS
FOR THE SUNDSTRAND PROPOSAL
(in Millions)

TOTAL BASE LEVEL MAINTENANCE COSTS = $49.52
ADJUSTED BASE LEVEL MAINTENANCE COSTS = $49.34

TOTAL MANHOUR COST SAVINGS = $0.1799

FACTOR 0.15
=============

SYSTEM	REMOVALS	ADJUSTED REMOVALS	DELTA	MMHTR	LABOR COST	MAINTENANCE MANHOURS COST SAVINGS
42XXX	1603	2128.46	-525.46	3.5	11.68	($0.0215)
51XXX	2358	2004.30	353.70	5.4	11.68	$0.0223
52XXX	2345	1993.25	351.75	7.4	11.68	$0.0304
61XXX	617	524.45	92.55	5.5	11.68	$0.0059
62XXX	427	362.95	64.05	5.1	11.68	$0.0038
63XXX	499	424.15	74.85	5.4	11.68	$0.0047
65XXX	525	446.25	78.75	6.0	11.68	$0.0055
66XXX	296	251.60	44.40	3.7	11.68	$0.0019
69XXX	72	61.20	10.80	7.5	11.68	$0.0009
71XXX	2194	1864.90	329.10	6.6	11.68	$0.0254
72XXX	8558	7274.30	1283.70	6.7	11.68	$0.1005
TOTAL	19,494	17,336	2158.19			$0.1799
MDS TOTAL	65,683					

COST OF BASE LEVEL MAINTENANCE MANHOURS FOR THE SUNDSTRAND PROPOSAL

(in Millions)

TOTAL BASE LEVEL MAINTENANCE COSTS =	$49.52
ADJUSTED BASE LEVEL MAINTENANCE COSTS =	$49.13
TOTAL MANHOUR COST SAVINGS =	$0.3813

FACTOR 0.3

============

SYSTEM	REMOVALS	ADJUSTED REMOVALS	DELTA	MMHTR	LABOR COST	MAINTENANCE MANHOURS COST SAVINGS
42XXX	1603	2128.46	-525.46	3.5	11.68	($0.0215)
51XXX	2358	1650.60	707.40	5.4	11.68	$0.0446
52XXX	2345	1641.50	703.50	7.4	11.68	$0.0608
61XXX	617	431.90	185.10	5.5	11.68	$0.0119
62XXX	427	298.90	128.10	5.1	11.68	$0.0076
63XXX	499	349.30	149.70	5.4	11.68	$0.0094
65XXX	525	367.50	157.50	6.0	11.68	$0.0110
66XXX	296	207.20	88.80	3.7	11.68	$0.0038
69XXX	72	50.40	21.60	7.5	11.68	$0.0019
71XXX	2194	1535.80	658.20	6.6	11.68	$0.0507
72XXX	8558	5990.60	2567.40	6.7	11.68	$0.2009
TOTAL	19,494	14,652	4841.84			$0.3813
MDS TOTAL	65,683					

Appendix D: Spreadsheets for the Westinghouse Proposal

COST OF MISSION ABORTS
FOR THE WESTINGHOUSE PROPOSAL
(in Millions)

Baseline FH Costs =		$393.800	Flying Hours =		117,421
			Sorties =		52648
FACTOR	0.05		Cost Sortie =		$0.0075

SYSTEM	NO. OF ABORTS	COST OF ABORTS	ADJUSTED NO. OF ABORTS	DELTA	ADJUSTED COST OF DELTA	COST SAVINGS
42XXX	60	$0.4488	60.11	-0.11	$0.4496	($0.0008)
51XXX	29	$0.2169	27.55	1.45	$0.2061	$0.0108
52XXX	21	$0.1571	19.95	1.05	$0.1492	$0.0079
61XXX	3	$0.0224	2.85	0.15	$0.0213	$0.0011
62XXX	6	$0.0449	5.70	0.30	$0.0426	$0.0022
63XXX	1	$0.0075	0.95	0.05	$0.0071	$0.0004
65XXX	6	$0.0449	5.70	0.30	$0.0426	$0.0022
66XXX	0	$0.0000	0.00	0.00	$0.0000	$0.0000
69XXX	0	$0.0000	0.00	0.00	$0.0000	$0.0000
71XXX	4	$0.0299	3.80	0.20	$0.0284	$0.0015
72XXX	48	$0.3590	45.60	2.40	$0.3411	$0.0180
Total	178	$1.3314	172.2068	5.7932	$1.2831	$0.0433

TOTAL COST SAVINGS FOR CHANGE IN ABORTS IS $0.0433

COST OF MISSION ABORTS
FOR THE WESTINGHOUSE PROPOSAL
(in Millions)

Baseline FH Costs =	$393.800	Flying Hours =	117,421
		Sorties =	52648
FACTOR	0.15	Cost/Sortie =	$0.0075
	====		

SYSTEM	NO. OF ABORTS	COST OF ABORTS	ADJUSTED NO. OF ABORTS	DELTA	ADJUSTED COST OF DELTA	COST SAVINGS
42XXX	60	$0.4488	60.11	-0.11	$0.4496	($0.0008)
51XXX	29	$0.2169	24.65	4.35	$0.1844	$0.0325
52XXX	21	$0.1571	17.85	3.15	$0.1335	$0.0236
61XXX	3	$0.0224	2.55	0.45	$0.0191	$0.0034
62XXX	6	$0.0449	5.10	0.90	$0.0381	$0.0067
63XXX	1	$0.0075	0.85	0.15	$0.0064	$0.0011
65XXX	6	$0.0449	5.10	0.90	$0.0381	$0.0067
66XXX	0	$0.0000	0.00	0.00	$0.0000	$0.0000
69XXX	0	$0.0000	0.00	0.00	$0.0000	$0.0000
71XXX	4	$0.0299	3.40	0.60	$0.0254	$0.0045
72XXX	48	$0.3590	40.80	7.20	$0.3052	$0.0539
Total	178	$1.3314	160.4068	17.5932	$1.1998	$0.1316

TOTAL COST SAVINGS FOR CHANGE IN ABORTS IS $0.1316

COST OF MISSION ABORTS
FOR THE WESTINGHOUSE PROPOSAL
(in Millions)

Baseline FH Costs =	$393.800	Flying Hours =	117,421
		Sorties =	52648
FACTOR 0.3		Cost/Sortie =	$0.0075

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SYSTEM	NO. OF ABORTS	COST OF ABORTS	ADJUSTED NO. OF ABORTS	DELTA	ADJUSTED COST OF DELTA	COST SAVINGS
42XXX	60	$0.4488	60.11	-0.11	$0.4496	($0.0008)
51XXX	29	$0.2169	20.30	8.70	$0.1518	$0.0651
52XXX	21	$0.1571	14.70	6.30	$0.1100	$0.0471
61XXX	3	$0.0224	2.10	0.90	$0.0157	$0.0067
62XXX	6	$0.0449	4.20	1.80	$0.0314	$0.0135
63XXX	1	$0.0075	0.70	0.30	$0.0052	$0.0022
65XXX	6	$0.0449	4.20	1.80	$0.0314	$0.0135
66XXX	0	$0.0000	0.00	0.00	$0.0000	$0.0000
69XXX	0	$0.0000	0.00	0.00	$0.0000	$0.0000
71XXX	4	$0.0299	2.80	1.20	$0.0209	$0.0090
72XXX	48	$0.3590	33.60	14.40	$0.2513	$0.1077
Total	178	$1.3314	142.7068	35.2932	$1.0674	$0.2640

TOTAL COST SAVINGS FOR CHANGE IN ABORTS IS $0.2640

COSTS OF REPLENISHMENT SPARES
FOR THE WESTINGHOUSE PROPOSAL
(in Millions)

BASELINE TOTAL REPLENISHMENT SPARES COST = 13.814 (in millions)

FACTOR 0.05

SYSTEM	REMOVALS	% OF TOTAL	COST OF SPARES	ADJUSTED REMOVALS	SAVINGS COST	ADJUSTED COST OF SPARES
42XXX	1603	0.0244	$0.3371	525.46	($0.1106)	$0.4477
51XXX	2358	0.0359	$0.4959	2240.10	$0.0248	$0.4711
52XXX	2345	0.0357	$0.4932	2227.75	$0.0247	$0.4685
61XXX	617	0.0094	$0.1298	586.15	$0.0065	$0.1233
62XXX	427	0.0065	$0.0898	405.65	$0.0045	$0.0853
63XXX	499	0.0076	$0.1049	474.05	$0.0052	$0.0997
65XXX	525	0.0080	$0.1104	498.75	$0.0055	$0.1049
66XXX	296	0.0045	$0.0623	281.20	$0.0031	$0.0591
69XXX	72	0.0011	$0.0151	68.40	$0.0008	$0.0144
71XXX	2194	0.0334	$0.4614	2084.30	$0.0231	$0.4384
72XXX	8558	0.1303	$1.7999	8130.10	$0.0900	$1.7099
TOTAL	19494	0.2968	$4.0998	17521.91	$0.0776	$4.0223
MDS TOTA	65683					

TOTAL SAVINGS FOR REPLENISHMENT SPARES = $0.0776

COSTS OF REPLENISHMENT SPARES
FOR THE WESTINGHOUSE PROPOSAL
(in Millions)

BASELINE TOTAL REPLENISHMENT SPARES COST = 13.814 (in millions)

FACTOR 0.15
===========

SYSTEM	REMOVALS	% OF TOTAL	COST OF SPARES	ADJUSTED REMOVALS	SAVINGS COST	ADJUSTED COST OF SPARES
42XXX	1603	0.0244	$0.3371	525.46	($0.1106)	$0.4477
51XXX	2358	0.0359	$0.4959	2004.30	$0.0744	$0.4215
52XXX	2345	0.0357	$0.4932	1993.25	$0.0740	$0.4192
61XXX	617	0.0094	$0.1298	524.45	$0.0195	$0.1103
62XXX	427	0.0065	$0.0898	362.95	$0.0135	$0.0763
63XXX	499	0.0076	$0.1049	424.15	$0.0157	$0.0892
65XXX	525	0.0080	$0.1104	446.25	$0.0166	$0.0939
66XXX	296	0.0045	$0.0623	251.60	$0.0093	$0.0529
69XXX	72	0.0011	$0.0151	61.20	$0.0023	$0.0129
71XXX	2194	0.0334	$0.4614	1864.90	$0.0692	$0.3922
72XXX	8558	0.1303	$1.7999	7274.30	$0.2700	$1.5299
TOTAL	19494	0.2968	$4.0998	15732.81	$0.4538	$3.6460
MDS TOTA	65683					

TOTAL SAVINGS FOR REPLENISHMENT SPARES = $0.4538

COSTS OF REPLENISHMENT SPARES
FOR THE WESTINGHOUSE PROPOSAL
(in Millions)

BASELINE TOTAL REPLENISHMENT SPARES COST = 13.814 (in millions)

FACTOR 0.3
===========

SYSTEM	REMOVALS	% OF TOTAL	COST OF SPARES	ADJUSTED REMOVALS	SAVINGS COST	ADJUSTED COST OF SPARES
42XXX	1603	0.0244	$0.3371	525.46	($0.1106)	$0.4477
51XXX	2358	0.0359	$0.4959	1650.60	$0.1488	$0.3471
52XXX	2345	0.0357	$0.4932	1641.50	$0.1480	$0.3452
61XXX	617	0.0094	$0.1298	431.90	$0.0389	$0.0908
62XXX	427	0.0065	$0.0898	298.90	$0.0269	$0.0629
63XXX	499	0.0076	$0.1049	349.30	$0.0315	$0.0735
65XXX	525	0.0080	$0.1104	367.50	$0.0331	$0.0773
66XXX	296	0.0045	$0.0623	207.20	$0.0187	$0.0436
69XXX	72	0.0011	$0.0151	50.40	$0.0045	$0.0106
71XXX	2194	0.0334	$0.4614	1535.80	$0.1384	$0.3230
72XXX	8558	0.1303	$1.7999	5990.60	$0.5400	$1.2599
TOTAL	19494	0.2968	$4.0998	13049.16	$1.0182	$3.0816
MDS TOTA	65683					

TOTAL SAVINGS FOR REPLENISHMENT SPARES = $1.0182

COSTS OF CONDEMNATION SPARES
FOR THE WESTINGHOUSE PROPOSAL
(in Millions)

MDS TOTAL CONDEMNATION SPARES COST = $2.3155

FACTOR = 0.05
=====

SYSTEM	COND. ITEMS	% OF TOTAL	COST OF COND. ITEMS	ADJUSTED COND. ITEMS	ADJUSTED COST	COST SAVINGS
42XXX	33	0.0485	$0.1122	0.41	$0.1136	($0.0014)
51XXX	9	0.0132	$0.0306	6.30	$0.0291	$0.0015
52XXX	15	0.0220	$0.0510	10.50	$0.0485	$0.0026
61XXX	22	0.0323	$0.0748	15.40	$0.0711	$0.0037
62XXX	4	0.0059	$0.0136	2.80	$0.0129	$0.0007
63XXX	2	0.0029	$0.0068	1.40	$0.0065	$0.0003
65XXX	3	0.0044	$0.0102	2.10	$0.0097	$0.0005
66XXX	12	0.0176	$0.0408	8.40	$0.0388	$0.0020
69XXX	30	0.0441	$0.1020	21.00	$0.0969	$0.0051
71XXX	32	0.0470	$0.1088	22.40	$0.1034	$0.0054
72XXX	70	0.1028	$0.2380	49.00	$0.2261	$0.0119
TOTAL	232	0.3407	$0.7888	139.71	$0.7564	$0.0324
MDS TOTAL	681					

COST SAVINGS ATTRIBUTED TO CONDEMNATION SPARES = $0.0324

COSTS OF CONDEMNATION SPARES
FOR THE WESTINGHOUSE PROPOSAL
(in Millions)

MDS TOTAL CONDEMNATION SPARES COST = $2.3155

FACTOR = 0.15

SYSTEM	===== COND. ITEMS	% OF TOTAL	COST OF COND. ITEMS	ADJUSTED COND. ITEMS	ADJUSTED COST	COST SAVINGS
42XXX	33	0.0485	$0.1122	0.41	$0.1136	($0.0014)
51XXX	9	0.0132	$0.0306	6.30	$0.0260	$0.0046
52XXX	15	0.0220	$0.0510	10.50	$0.0434	$0.0077
61XXX	22	0.0323	$0.0748	15.40	$0.0636	$0.0112
62XXX	4	0.0059	$0.0136	2.80	$0.0116	$0.0020
63XXX	2	0.0029	$0.0068	1.40	$0.0058	$0.0010
65XXX	3	0.0044	$0.0102	2.10	$0.0087	$0.0015
66XXX	12	0.0176	$0.0408	8.40	$0.0347	$0.0061
69XXX	30	0.0441	$0.1020	21.00	$0.0867	$0.0153
71XXX	32	0.0470	$0.1088	22.40	$0.0925	$0.0163
72XXX	70	0.1028	$0.2380	49.00	$0.2023	$0.0357
TOTAL	232	0.3407	$0.7888	139.71	$0.6887	$0.1001
MDS TOTAL	681					

COST SAVINGS ATTRIBUTED TO CONDEMNATION SPARES = $0.1001

COSTS OF CONDEMNATION SPARES
FOR THE WESTINGHOUSE PROPOSAL
(in Millions)

MDS TOTAL CONDEMNATION SPARES COST = $2.3155

FACTOR = 0.3

SYSTEM	COND. ITEMS	% OF TOTAL	COST OF COND. ITEMS	ADJUSTED COND. ITEMS	ADJUSTED COST	COST SAVINGS
42XXX	33	0.0485	$0.1122	0.41	$0.1136	($0.0014)
51XXX	9	0.0132	$0.0306	6.30	$0.0214	$0.0092
52XXX	15	0.0220	$0.0510	10.50	$0.0357	$0.0153
61XXX	22	0.0323	$0.0748	15.40	$0.0524	$0.0224
62XXX	4	0.0059	$0.0136	2.80	$0.0095	$0.0041
63XXX	2	0.0029	$0.0068	1.40	$0.0048	$0.0020
65XXX	3	0.0044	$0.0102	2.10	$0.0071	$0.0031
66XXX	12	0.0176	$0.0408	8.40	$0.0286	$0.0122
69XXX	30	0.0441	$0.1020	21.00	$0.0714	$0.0306
71XXX	32	0.0470	$0.1088	22.40	$0.0762	$0.0326
72XXX	70	0.1028	$0.2380	49.00	$0.1666	$0.0714
TOTAL	232	0.3407	$0.7888	139.71	$0.5872	$0.2016
MDS TOTAL	681					

COST SAVINGS ATTRIBUTED TO CONDEMNATION SPARES = $0.2016

COSTS OF REPAIR COSTS
FOR THE WESTINGHOUSE PROPOSAL
(in Millions)

MDS TOTAL REPAIR COST = $6.8207
FACTOR = 0.05
=====

ADJUSTED COST OF COND. ITEMS	SYSTEM	REPAIR COSTS	% OF TOTAL	ADJUSTED REPAIR COSTS	SAVINGS COST
$0.1131	42XXX	$0.6975	0.1023	$0.7016	($0.0041)
$0.0291	51XXX	$0.9136	0.1339	$0.8679	$0.0457
$0.0485	52XXX	$1.5399	0.2258	$1.4629	$0.0770
$0.0711	61XXX	$0.1524	0.0223	$0.1448	$0.0076
$0.0129	62XXX	$0.0721	0.0106	$0.0685	$0.0036
$0.0065	63XXX	$0.0650	0.0095	$0.0618	$0.0033
$0.0097	65XXX	$0.0740	0.0108	$0.0703	$0.0037
$0.0388	66XXX	$0.0053	0.0008	$0.0050	$0.0003
$0.0969	69XXX	$0.0030	0.0004	$0.0029	$0.0002
$0.1034	71XXX	$0.2955	0.0433	$0.2807	$0.0148
$0.2261	72XXX	$3.0024	0.4402	$2.8523	$0.1501
$0.7559	TOTAL	$6.8207	1.0000	$6.5186	$0.3021

THE REPAIR COST SAVINGS = $0.3021

COSTS OF REPAIR COSTS
FOR THE WESTINGHOUSE PROPOSAL
(in Millions)

MDS TOTAL REPAIR COST = $6.8207
FACTOR = 0.15
=====

ADJUSTED COST OF COND. ITEMS	SYSTEM	REPAIR COSTS	% OF TOTAL	ADJUSTED REPAIR COSTS	SAVINGS COST
$0.1131	42XXX	$0.6975	0.1023	$0.7016	($0.0041)
$0.0291	51XXX	$0.9136	0.1339	$0.7766	$0.1370
$0.0485	52XXX	$1.5399	0.2258	$1.3089	$0.2310
$0.0711	61XXX	$0.1524	0.0223	$0.1295	$0.0229
$0.0129	62XXX	$0.0721	0.0106	$0.0613	$0.0108
$0.0065	63XXX	$0.0650	0.0095	$0.0553	$0.0098
$0.0097	65XXX	$0.0740	0.0108	$0.0629	$0.0111
$0.0388	66XXX	$0.0053	0.0008	$0.0045	$0.0008
$0.0969	69XXX	$0.0030	0.0004	$0.0026	$0.0005
$0.1034	71XXX	$0.2955	0.0433	$0.2511	$0.0443
$0.2261	72XXX	$3.0024	0.4402	$2.5521	$0.4504
$0.7559	TOTAL	$6.8207	1.0000	$5.9063	$0.9144

THE REPAIR COST SAVINGS = $0.9144

COSTS OF REPAIR COSTS
FOR THE WESTINGHOUSE PROPOSAL
(in Millions)

MDS TOTAL REPAIR COST = $6.8207
FACTOR = 0.3
=====

ADJUSTED COST OF COND. ITEMS	SYSTEM	REPAIR COSTS	% OF TOTAL	ADJUSTED REPAIR COSTS	SAVINGS COST
$0.1131	42XXX	$0.6975	0.1023	$0.7016	($0.0041)
$0.0291	51XXX	$0.9136	0.1339	$0.6395	$0.2741
$0.0485	52XXX	$1.5399	0.2258	$1.0779	$0.4620
$0.0711	61XXX	$0.1524	0.0223	$0.1067	$0.0457
$0.0129	62XXX	$0.0721	0.0106	$0.0505	$0.0216
$0.0065	63XXX	$0.0650	0.0095	$0.0455	$0.0195
$0.0097	65XXX	$0.0740	0.0108	$0.0518	$0.0222
$0.0388	66XXX	$0.0053	0.0008	$0.0037	$0.0016
$0.0969	69XXX	$0.0030	0.0004	$0.0021	$0.0009
$0.1034	71XXX	$0.2955	0.0433	$0.2068	$0.0886
$0.2261	72XXX	$3.0024	0.4402	$2.1017	$0.9007
$0.7559	TOTAL	$6.8207	1.0000	$4.9879	$1.8329

THE REPAIR COST SAVINGS = $1.8329

2nd DESTINATION TRANSPORTATION COSTS FOR THE WESTINGHOUSE PROPOSAL
(in Millions)

MDS TOTAL 2nd DEST. TRANSPORTATION COST = $3.6306
FACTOR 0.05

=====

SYSTEM	NUMBER OF NRTS ITEMS	NUMBER NRTS AND CONDEMNED ITEMS	TRANS. COSTS	ADJUSTED NUMBER OF NRTS ITEMS	ADJUSTED TRANS. COSTS OF NRTS ITEMS	SAVINGS COST
42XXX	162	195.00	$0.1559	200.000	$0.1599	($0.0040)
51XXX	916	925.00	$0.7394	878.750	$0.7024	$0.0370
52XXX	1109	1124.00	$0.8984	1067.800	$0.8535	$0.0449
61XXX	132	154.00	$0.1231	146.300	$0.1169	$0.0062
62XXX	135	139.00	$0.1111	132.050	$0.1056	$0.0056
63XXX	115	117.00	$0.0935	111.150	$0.0888	$0.0047
65XXX	173	176.00	$0.1407	167.200	$0.1336	$0.0070
66XXX	10	22.00	$0.0176	20.900	$0.0167	$0.0009
69XXX	5	35.00	$0.0280	33.250	$0.0266	$0.0014
71XXX	374	406.00	$0.3245	385.700	$0.3083	$0.0162
72XXX	1179	1249.00	$0.9984	1186.550	$0.9484	$0.0499
TOTAL	4310	4542.00	$3.6306	4329.659	$3.4608	$0.1697
MDS TOT	7668					

2nd DESTINATION TRANSPORTATION COST SAVINGS = $0.1697

2nd DESTINATION TRANSPORTATION COSTS
FOR THE WESTINGHOUSE PROPOSAL
(in Millions)

MDS TOTAL 2nd DEST. TRANSPORTATION COST = $3.6306

FACTOR 0.15

SYSTEM	NUMBER OF NRTS ITEMS	NUMBER NRTS AND CONDEMNED ITEMS	TRANS. COSTS	ADJUSTED NUMBER OF NRTS ITEMS	ADJUSTED TRANS. COSTS OF NRTS ITEMS	SAVINGS COST
42XXX	162	195.00	$0.1559	200.009	$0.1599	($0.0040)
51XXX	916	925.00	$0.7394	786.250	$0.6285	$0.1109
52XXX	1109	1124.00	$0.8984	955.400	$0.7637	$0.1348
61XXX	132	154.00	$0.1231	130.900	$0.1046	$0.0185
62XXX	135	139.00	$0.1111	118.150	$0.0944	$0.0167
63XXX	115	117.00	$0.0935	99.450	$0.0795	$0.0140
65XXX	173	176.00	$0.1407	149.600	$0.1196	$0.0211
66XXX	10	22.00	$0.0176	18.700	$0.0149	$0.0026
69XXX	5	35.00	$0.0280	29.750	$0.0238	$0.0042
71XXX	374	406.00	$0.3245	345.100	$0.2758	$0.0487
72XXX	1179	1249.00	$0.9984	1061.650	$0.8486	$0.1498
TOTAL	4310	4542.00	$3.6306	3894.959	$3.1134	$0.5172
MDS TOT	7668					

2nd DESTINATION TRANSPORTATION COST SAVINGS = $0.5172

2nd DESTINATION TRANSPORTATION COSTS FOR THE WESTINGHOUSE PROPOSAL
(in Millions)

MDS TOTAL 2nd DEST. TRANSPORTATION COST = $3.6306

FACTOR 0.3

SYSTEM	===== NUMBER OF NRTS ITEMS	NUMBER NRTS AND CONDEMNED ITEMS	TRANS. COSTS	ADJUSTED NUMBER OF NRTS ITEMS	ADJUSTED TRANS. COSTS OF NRTS ITEMS	SAVINGS COST
42XXX	162	195.00	$0.1559	200.009	$0.1599	($0.0040)
51XXX	916	925.00	$0.7394	647.500	$0.5176	$0.2218
52XXX	1109	1124.00	$0.8984	786.800	$0.6289	$0.2695
61XXX	132	154.00	$0.1231	107.800	$0.0862	$0.0369
62XXX	135	139.00	$0.1111	97.300	$0.0778	$0.0333
63XXX	115	117.00	$0.0935	81.900	$0.0655	$0.0281
65XXX	173	176.00	$0.1407	123.200	$0.0985	$0.0422
66XXX	10	22.00	$0.0176	15.400	$0.0123	$0.0053
69XXX	5	35.00	$0.0280	24.500	$0.0196	$0.0084
71XXX	374	406.00	$0.3245	284.200	$0.2272	$0.0974
72XXX	1179	1249.00	$0.9984	874.300	$0.6989	$0.2995
TOTAL	4310	4542.00	$3.6306	3242.909	$2.5922	$1.0384
MDS TOT	7668					

2nd DESTINATION TRANSPORTATION COST SAVINGS = $1.0384

COST OF BASE LEVEL MAINTENANCE MANHOURS
FOR THE WESTINGHOUSE PROPOSAL
(in Millions)

TOTAL BASE LEVEL MAINTENANCE COSTS = $49.52
ADJUSTED BASE LEVEL MAINTENANCE COSTS = $49.45

TOTAL MANHOUR COST SAVINGS = $0.0655

FACTOR 0.05
============

SYSTEM	REMOVALS	ADJUSTED REMOVALS	DELTA	MMHTR	LABOR COST	MAINTENANCE MANHOURS COST SAVINGS
42XXX	1603	1642.41	-39.41	3.5	11.68	($0.0016)
51XXX	2358	2240.10	117.90	5.4	11.68	$0.0074
52XXX	2345	2227.75	117.25	7.4	11.68	$0.0101
61XXX	617	586.15	30.85	5.5	11.68	$0.0020
62XXX	427	405.65	21.35	5.1	11.68	$0.0013
63XXX	499	474.05	24.95	5.4	11.68	$0.0016
65XXX	525	498.75	26.25	6.0	11.68	$0.0018
66XXX	296	281.20	14.80	3.7	11.68	$0.0006
69XXX	72	68.40	3.60	7.5	11.68	$0.0003
71XXX	2194	2084.30	109.70	6.6	11.68	$0.0085
72XXX	8558	8130.10	427.90	6.7	11.68	$0.0335
TOTAL	19,494	18,639	855.14			$0.0655
MDS TOTAL	65,683					

COST OF BASE LEVEL MAINTENANCE MANHOURS
FOR THE WESTINGHOUSE PROPOSAL
(in Millions)

TOTAL BASE LEVEL MAINTENANCE COSTS =	$49.52
ADJUSTED BASE LEVEL MAINTENANCE COSTS =	$49.32
TOTAL MANHOUR COST SAVINGS =	$0.1998
FACTOR	0.15

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SYSTEM	REMOVALS	ADJUSTED REMOVALS	DELTA	MMHTR	LABOR COST	MAINTENANCE MANHOURS COST SAVINGS
42XXX	1603	1642.41	-39.41	3.5	11.68	($0.0016)
51XXX	2358	2004.30	353.70	5.4	11.68	$0.0223
52XXX	2345	1993.25	351.75	7.4	11.68	$0.0304
61XXX	617	524.45	92.55	5.5	11.68	$0.0059
62XXX	427	362.95	64.05	5.1	11.68	$0.0038
63XXX	499	424.15	74.85	5.4	11.68	$0.0047
65XXX	525	446.25	78.75	6.0	11.68	$0.0055
66XXX	296	251.60	44.40	3.7	11.68	$0.0019
69XXX	72	61.20	10.80	7.5	11.68	$0.0009
71XXX	2194	1864.90	329.10	6.6	11.68	$0.0254
72XXX	8558	7274.30	1283.70	6.7	11.68	$0.1005
TOTAL	19,494	16,850	2644.24			$0.1998
MDS TOTAL	65,683					

COST OF BASE LEVEL MAINTENANCE MANHOURS FOR THE WESTINGHOUSE PROPOSAL
(in Millions)

TOTAL BASE LEVEL MAINTENANCE COSTS =	$49.52
ADJUSTED BASE LEVEL MAINTENANCE COSTS =	$49.11
TOTAL MANHOUR COST SAVINGS =	$0.4012

FACTOR 0.3

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SYSTEM	REMOVALS	ADJUSTED REMOVALS	DELTA	MMHTR	LABOR COST	MAINTENANCE MANHOURS COST SAVINGS
42XXX	1603	1642.41	-39.41	3.5	11.68	($0.0016)
51XXX	2358	1650.60	707.40	5.4	11.68	$0.0446
52XXX	2345	1641.50	703.50	7.4	11.68	$0.0608
61XXX	617	431.90	185.10	5.5	11.68	$0.0119
62XXX	427	298.90	128.10	5.1	11.68	$0.0076
63XXX	499	349.30	149.70	5.4	11.68	$0.0094
65XXX	525	367.50	157.50	6.0	11.68	$0.0110
66XXX	296	207.20	88.80	3.7	11.68	$0.0038
69XXX	72	50.40	21.60	7.5	11.68	$0.0019
71XXX	2194	1535.80	658.20	6.6	11.68	$0.0507
72XXX	8558	5990.60	2567.40	6.7	11.68	$0.2009
TOTAL	19,494	14,166	5327.89			$0.4012
MDS TOTAL	65,683					

Appendix E: Spreadsheets for the Leland Proposal

COST OF MISSION ABORTS
FOR THE LELAND PROPOSAL
(in Millions)

Baseline FH Costs =		$393.800	Flying Hours =		117,421	
			Sorties =		52648	
FACTOR	0.15		Cost/Sortie =		$0.0075	
	====					
SYSTEM	NO. OF ABORTS	COST OF ABORTS	ADJUSTED NO. OF ABORTS	DELTA	ADJUSTED COST OF DELTA	COST SAVINGS
42XXX	60	$0.4488	59.47	0.53	$0.4448	$0.0040
51XXX	29	$0.2169	24.65	4.35	$0.1844	$0.0325
52XXX	21	$0.1571	17.85	3.15	$0.1335	$0.0236
61XXX	3	$0.0224	2.55	0.45	$0.0191	$0.0034
62XXX	6	$0.0449	5.10	0.90	$0.0381	$0.0067
63XXX	1	$0.0075	0.85	0.15	$0.0064	$0.0011
65XXX	6	$0.0449	5.10	0.90	$0.0381	$0.0067
66XXX	0	$0.0000	0.00	0.00	$0.0000	$0.0000
69XXX	0	$0.0000	0.00	0.00	$0.0000	$0.0000
71XXX	4	$0.0299	3.40	0.60	$0.0254	$0.0045
72XXX	48	$0.3590	40.80	7.20	$0.3052	$0.0539
Total	178	$1.3314	159.766	18.234	$1.1950	$0.1364

TOTAL COST SAVINGS FOR CHANGE IN ABORTS IS $0.1364

COST OF MISSION ABORTS
FOR THE LELAND PROPOSAL
(in Millions)

Baseline FH Costs =	$393.800	Flying Hours =	117,421
		Sorties =	52648
FACTOR 0.3		Cost/Sortie =	$0.0075

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SYSTEM	NO. OF ABORTS	COST OF ABORTS	ADJUSTED NO. OF ABORTS	DELTA	ADJUSTED COST OF DELTA	COST SAVINGS
42XXX	60	$0.4488	59.47	0.53	$0.4448	$0.0040
51XXX	29	$0.2169	20.30	8.70	$0.1518	$0.0651
52XXX	21	$0.1571	14.70	6.30	$0.1100	$0.0471
61XXX	3	$0.0224	2.10	0.90	$0.0157	$0.0067
62XXX	6	$0.0449	4.20	1.80	$0.0314	$0.0135
63XXX	1	$0.0075	0.70	0.30	$0.0052	$0.0022
65XXX	6	$0.0449	4.20	1.80	$0.0314	$0.0135
66XXX	0	$0.0000	0.00	0.00	$0.0000	$0.0000
69XXX	0	$0.0000	0.00	0.00	$0.0000	$0.0000
71XXX	4	$0.0299	2.80	1.20	$0.0209	$0.0090
72XXX	48	$0.3590	33.60	14.40	$0.2513	$0.1077
Total	178	$1.3314	142.066	35.934	$1.0626	$0.2688

TOTAL COST SAVINGS FOR CHANGE IN ABORTS IS $0.2688

COST OF MISSION ABORTS
FOR THE LELAND PROPOSAL
(in Millions)

Baseline FH Costs =	$393.800	Flying Hours =	117,421
		Sorties =	52648
FACTOR	0.05	Cost/Sortie =	$0.0075

SYSTEM	NO. OF ABORTS	COST OF ABORTS	ADJUSTED NO. OF ABORTS	DELTA	ADJUSTED COST OF DELTA	COST SAVINGS
42XXX	60	$0.4488	59.47	0.53	$0.4448	$0.0040
51XXX	29	$0.2169	27.55	1.45	$0.2061	$0.0108
52XXX	21	$0.1571	19.95	1.05	$0.1492	$0.0079
61XXX	3	$0.0224	2.85	0.15	$0.0213	$0.0011
62XXX	6	$0.0449	5.70	0.30	$0.0426	$0.0022
63XXX	1	$0.0075	0.95	0.05	$0.0071	$0.0004
65XXX	6	$0.0449	5.70	0.30	$0.0426	$0.0022
66XXX	0	$0.0000	0.00	0.00	$0.0000	$0.0000
69XXX	0	$0.0000	0.00	0.00	$0.0000	$0.0000
71XXX	4	$0.0299	3.80	0.20	$0.0284	$0.0015
72XXX	48	$0.3590	45.60	2.40	$0.3411	$0.0180
Total	178	$1.3314	171.566	6.434	$1.2833	$0.0481

TOTAL COST SAVINGS FOR CHANGE IN ABORTS IS $0.0481

COSTS OF REPLENISHMENT SPARES
FOR THE LELAND PROPOSAL
(in Millions)

BASELINE TOTAL REPLENISHMENT SPARES COST = 13.814 (in millions)

FACTOR 0.05

SYSTEM	REMOVALS	% OF TOTAL	COST OF SPARES	ADJUSTED REMOVALS	SAVINGS COST	ADJUSTED COST OF SPARES
42XXX	1603	0.0244	$0.3371	197.05	$0.0415	$0.2956
51XXX	2358	0.0359	$0.4959	2240.10	$0.0248	$0.4711
52XXX	2345	0.0357	$0.4932	2227.75	$0.0247	$0.4685
61XXX	617	0.0094	$0.1298	586.15	$0.0065	$0.1233
62XXX	427	0.0065	$0.0898	405.65	$0.0045	$0.0853
63XXX	499	0.0076	$0.1049	474.05	$0.0052	$0.0997
65XXX	525	0.0080	$0.1104	498.75	$0.0055	$0.1049
66XXX	296	0.0045	$0.0623	281.20	$0.0031	$0.0591
69XXX	72	0.0011	$0.0151	68.40	$0.0008	$0.0144
71XXX	2194	0.0334	$0.4614	2084.30	$0.0231	$0.4384
72XXX	8558	0.1303	$1.7999	8130.10	$0.0900	$1.7099
TOTAL	19494	0.2968	$4.0998	17193.50	$0.2296	$3.8702
MDS TOTA	65683					

TOTAL SAVINGS FOR REPLENISHMENT SPARES = $0.2296

COSTS OF REPLENISHMENT SPARES
FOR THE LELAND PROPOSAL
(in Millions)

BASELINE TOTAL REPLENISHMENT SPARES COST = 13.814 (in millions)

FACTOR 0.15

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SYSTEM	REMOVALS	% OF TOTAL	COST OF SPARES	ADJUSTED REMOVALS	SAVINGS COST	ADJUSTED COST OF SPARES
42XXX	1603	0.0244	$0.3371	197.05	$0.0415	$0.2956
51XXX	2358	0.0359	$0.4959	2004.30	$0.0744	$0.4215
52XXX	2345	0.0357	$0.4932	1993.25	$0.0740	$0.4192
61XXX	617	0.0094	$0.1298	524.45	$0.0195	$0.1103
62XXX	427	0.0065	$0.0898	362.95	$0.0135	$0.0763
63XXX	499	0.0076	$0.1049	424.15	$0.0157	$0.0892
65XXX	525	0.0080	$0.1104	446.25	$0.0166	$0.0939
66XXX	296	0.0045	$0.0623	251.60	$0.0093	$0.0529
69XXX	72	0.0011	$0.0151	61.20	$0.0023	$0.0129
71XXX	2194	0.0334	$0.4614	1864.90	$0.0692	$0.3922
72XXX	8558	0.1303	$1.7999	7274.30	$0.2700	$1.5299
TOTAL	19494	0.2968	$4.0998	15404.40	$0.6059	$3.4939
MDS TOTA	65683					

TOTAL SAVINGS FOR REPLENISHMENT SPARES = $0.6059

COSTS OF REPLENISHMENT SPARES
FOR THE LELAND PROPOSAL
(in Millions)

BASELINE TOTAL REPLENISHMENT SPARES COST = 13.814 (in millions)

FACTOR 0.3

SYSTEM	REMOVALS	% OF TOTAL	COST OF SPARES	ADJUSTED REMOVALS	SAVINGS COST	ADJUSTED COST OF SPARES
42XXX	1603	0.0244	$0.3371	197.05	$0.0415	$0.2956
51XXX	2358	0.0359	$0.4959	1650.60	$0.1488	$0.3471
52XXX	2345	0.0357	$0.4932	1641.50	$0.1480	$0.3452
61XXX	617	0.0094	$0.1298	431.90	$0.0389	$0.0908
62XXX	427	0.0065	$0.0898	298.90	$0.0269	$0.0629
63XXX	499	0.0076	$0.1049	349.30	$0.0315	$0.0735
65XXX	525	0.0080	$0.1104	367.50	$0.0331	$0.0773
66XXX	296	0.0045	$0.0623	207.20	$0.0187	$0.0436
69XXX	72	0.0011	$0.0151	50.40	$0.0045	$0.0106
71XXX	2194	0.0334	$0.4614	1535.80	$0.1384	$0.3230
72XXX	8558	0.1303	$1.7999	5990.60	$0.5400	$1.2599
TOTAL	19494	0.2968	$4.0998	12720.75	$1.1703	$2.9295
MDS TOTA	65683					

TOTAL SAVINGS FOR REPLENISHMENT SPARES = $1.1703

COSTS OF CONDEMNATION SPARES
FOR THE LELAND PROPOSAL
(in Millions)

MDS TOTAL CONDEMNATION SPARES COST = $2.3155

FACTOR = 0.05

SYSTEM	COND. ITEMS	% OF TOTAL	COST OF COND. ITEMS	ADJUSTED COND. ITEMS	ADJUSTED COST	COST SAVINGS
42XXX	33	0.0485	$0.1122	2.04	$0.1053	$0.0069
51XXX	9	0.0132	$0.0306	6.30	$0.0291	$0.0015
52XXX	15	0.0220	$0.0510	10.50	$0.0485	$0.0026
61XXX	22	0.0323	$0.0748	15.40	$0.0711	$0.0037
62XXX	4	0,0059	$0.0136	2.80	$0.0129	$0.0007
63XXX	2	0.0029	$0.0068	1.40	$0.0065	$0.0003
65XXX	3	0.0044	$0.0102	2.10	$0.0097	$0.0005
66XXX	12	0.0176	$0.0408	8.40	$0.0388	$0.0020
69XXX	30	0.0441	$0.1020	21.00	$0.0969	$0.0051
71XXX	32	0.0470	$0.1088	22.40	$0.1034	$0.0054
72XXX	70	0.1028	$0.2380	49.00	$0.2261	$0.0119
TOTAL	232	0.3407	$0.7888	141.34	$0.7481	$0.0408
MDS TOTAL	681					

COST SAVINGS ATTRIBUTED TO CONDEMNATION SPARES = $0.0408

COSTS OF CONDEMNATION SPARES
FOR THE LELAND PROPOSAL
(in Millions)

MDS TOTAL CONDEMNATION SPARES COST = $2.3155

FACTOR = 0.15
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SYSTEM	COND. ITEMS	% OF TOTAL	COST OF COND. ITEMS	ADJUSTED COND. ITEMS	ADJUSTED COST	COST SAVINGS
42XXX	33	0.0485	$0.1122	2.04	$0.1053	$0.0069
51XXX	9	0.0132	$0.0306	6.30	$0.0260	$0.0046
52XXX	15	0.0220	$0.0510	10.50	$0.0434	$0.0077
61XXX	22	0.0323	$0.0748	15.40	$0.0636	$0.0112
62XXX	4	0.0059	$0.0136	2.80	$0.0116	$0.0020
63XXX	2	0.0029	$0.0068	1.40	$0.0058	$0.0010
65XXX	3	0.0044	$0.0102	2.10	$0.0087	$0.0015
66XXX	12	0.0176	$0.0408	8.40	$0.0347	$0.0061
69XXX	30	0.0441	$0.1020	21.00	$0.0867	$0.0153
71XXX	32	0.0470	$0.1088	22.40	$0.0925	$0.0163
72XXX	70	0.1028	$0.2380	49.00	$0.2023	$0.0357
TOTAL	232	0.3407	$0.7888	141.34	$0.6804	$0.1084
MDS TOTAL	681					

COST SAVINGS ATTRIBUTED TO CONDEMNATION SPARES = $0.1084

COSTS OF CONDEMNATION SPARES
FOR THE LELAND PROPOSAL
(in Millions)

MDS TOTAL CONDEMNATION SPARES COST = $2.3155

FACTOR = 0.3

SYSTEM	===== COND. ITEMS	% OF TOTAL	COST OF COND. ITEMS	ADJUSTED COND. ITEMS	ADJUSTED COST	COST SAVINGS
42XXX	33	0.0485	$0.1122	2.04	$0.1053	$0.0069
51XXX	9	0.0132	$0.0306	6.30	$0.0214	$0.0092
52XXX	15	0.0220	$0.0510	10.50	$0.0357	$0.0153
61XXX	22	0.0323	$0.0748	15.40	$0.0524	$0.0224
62XXX	4	0.0059	$0.0136	2.80	$0.0095	$0.0041
63XXX	2	0.0029	$0.0068	1.40	$0.0048	$0.0020
65XXX	3	0.0044	$0.0102	2.10	$0.0071	$0.0031
66XXX	12	0.0176	$0.0408	8.40	$0.0286	$0.0122
69XXX	30	0.0441	$0.1020	21.00	$0.0714	$0.0306
71XXX	32	0.0470	$0.1088	22.40	$0.0762	$0.0325
72XXX	70	0.1028	$0.2380	49.00	$0.1666	$0.0714
TOTAL	232	0.3407	[illegible]	141.34	$0.5789	$0.2099
MDS TOTAL	681					

COST SAVINGS ATTRIBUTED TO CONDEMNATION SPARES = $0.2099

COSTS OF REPAIR COSTS
FOR THE LELAND PROPOSAL
(in Millions)

MDS TOTAL REPAIR COST = $6.8207

FACTOR = 0.05

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ADJUSTED COST OF COND. ITEMS	SYSTEM	REPAIR COSTS	% OF TOTAL	ADJUSTED REPAIR COSTS	SAVINGS COST
$0.1131	42XXX	$0.6975	0.1023	$0.6771	$0.0205
$0.0291	51XXX	$0.9136	0.1339	$0.8579	$0.0457
$0.0485	52XXX	$1.5399	0.2258	$1.4629	$0.0770
$0.0711	61XXX	$0.1524	0.0223	$0.1448	$0.0076
$0.0129	62XXX	$0.0721	0.0106	$0.0685	$0.0036
$0.0065	63XXX	$0.0650	0.0095	$0.0618	$0.0033
$0.0097	65XXX	$0.0740	0.0108	$0.0703	$0.0037
$0.0383	66XXX	$0.0053	0.0008	$0.0050	$0.0003
$0.0969	69XXX	$0.0030	0.0004	$0.0029	$0.0002
$0.1034	71XXX	$0.2955	0.0433	$0.2807	$0.0148
$0.2261	72XXX	$3.0024	0.4402	$2.8523	$0.1501
$0.7559	TOTAL	$6.8207	1.0000	$6.4941	$0.3266

THE REPAIR COST SAVINGS = $0.3266

COSTS OF REPAIR COSTS
FOR THE LELAND PROPOSAL
(in Millions)

MDS TOTAL REPAIR COST = $6.8207

FACTOR = 0.15

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ADJUSTED COST OF COND. ITEMS	SYSTEM	REPAIR COSTS	% OF TOTAL	ADJUSTED REPAIR COSTS	SAVINGS COST
$0.1131	42XXX	$0.6975	0.1023	$0.6771	$0.0203
$0.0291	51XXX	$0.9136	0.1339	$0.7766	$0.1370
$0.0485	52XXX	$1.5399	0.2258	$1.3089	$0.2310
$0.0711	61XXX	$0.1524	0.0223	$0.1295	$0.0229
$0.0129	62XXX	$0.0721	0.0106	$0.0613	$0.0108
$0.0065	63XXX	$0.0650	0.0095	$0.0553	$0.0098
$0.0097	65XXX	$0.0740	0.0108	$0.0629	$0.0111
$0.0388	66XXX	$0.0053	0.0008	$0.0045	$0.0008
$0.0969	69XXX	$0.0030	0.0004	$0.0026	$0.0005
$0.1034	71XXX	$0.2955	0.0433	$0.2511	$0.0443
$0.2261	72XXX	$3.0024	0.4402	$2.5521	$0.4504
$0.7559	TOTAL	$6.8207	1.0000	$5.8818	$0.9389

THE REPAIR COST SAVINGS = $0.9389

COSTS OF REPAIR COSTS
FOR THE LELAND PROPOSAL
(in Millions)

MDS TOTAL REPAIR COST = $6.8207
FACTOR = 0.3
=====

ADJUSTED COST OF COND. ITEMS	SYSTEM	REPAIR COSTS	% OF TOTAL	ADJUSTED REPAIR COSTS	SAVINGS COST
$0.1131	42XXX	$0.6975	0.1023	$0.6771	$0.0205
$0.0291	51XXX	$0.9136	0.1339	$0.6395	$0.2741
$0.0485	52XXX	$1.5399	0.2258	$1.0779	$0.4620
$0.0711	61XXX	$0.1524	0.0223	$0.1067	$0.0457
$0.0129	62XXX	$0.0721	0.0106	$0.0505	$0.0216
$0.0065	63XXX	$0.0650	0.0095	$0.0455	$0.0195
$0.0097	65XXX	$0.0740	0.0108	$0.0518	$0.0222
$0.0388	66XXX	$0.0053	0.0008	$0.0037	$0.0016
$0.0969	69XXX	$0.0030	0.0004	$0.0021	$0.0009
$0.1034	71XXX	$0.2955	0.0433	$0.2068	$0.0886
$0.2261	72XXX	$3.0024	0.4402	$2.1017	$0.9007
$0.7559	TOTAL	$6.8207	1.0000	$4.9633	$1.8574

THE REPAIR COST SAVINGS = $1.8574

2nd DESTINATION TRANSPORTATION COSTS
FOR THE LELAND PROPOSAL
(in Millions)

MDS TOTAL 2nd DEST. TRANSPORTATION COST = $3.6306

FACTOR 0.05

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SYSTEM	NUMBER OF NRTS ITEMS	NUMBER NRTS AND CONDEMNED ITEMS	TRANS. COSTS	ADJUSTED NUMBER OF NRTS ITEMS	ADJUSTED TRANS. COSTS OF NRTS ITEMS	SAVINGS COST
42XXX	162	195.00	$0.1559	169.953	$0.1358	$0.0200
51XXX	916	925.00	$0.7394	878.750	$0.7024	$0.0370
52XXX	1109	1124.00	$0.8984	1067.800	$0.8535	$0.0449
61XXX	132	154.00	$0.1231	146.300	$0.1169	$0.0062
62XXX	135	139.00	$0.1111	132.050	$0.1056	$0.0056
63XXX	115	117.00	$0.0935	111.150	$0.0888	$0.0047
65XXX	173	176.00	$0.1407	167.200	$0.1336	$0.0070
66XXX	10	22.00	$0.0176	20.900	$0.0167	$0.0009
69XXX	5	35.00	$0.0280	33.250	$0.0266	$0.0014
71XXX	374	406.00	$0.3245	385.700	$0.3083	$0.0162
72XXX	1179	1249.00	$0.9984	1186.550	$0.9484	$0.0499
TOTAL	4310	4542.00	$3.6306	4299.603	$3.4368	$0.1938
MDS TOT	7668					

2nd DESTINATION TRANSPORTATION COST SAVINGS = $0.1938

2nd DESTINATION TRANSPORTATION COSTS FOR THE LELAND PROPOSAL (in Millions)

MDS TOTAL 2nd DEST. TRANSPORTATION COST = $3.6306

FACTOR 0.15

SYSTEM	===== NUMBER OF NRTS ITEMS	NUMBER NRTS AND CONDEMNED ITEMS	TRANS. COSTS	ADJUSTED NUMBER OF NRTS ITEMS	ADJUSTED TRANS. COSTS OF NRTS ITEMS	SAVINGS COST
42XXX	162	195.00	$0.1559	169.953	$0.1358	$0.0200
51XXX	916	925.00	$0.7394	786.250	$0.6285	$0.1109
52XXX	1109	1124.00	$0.8984	955.400	$0.7637	$0.1348
61XXX	132	154.00	$0.1231	130.900	$0.1046	$0.0185
62XXX	135	139.00	$0.1111	118.150	$0.0944	$0.0167
63XXX	115	117.00	$0.0935	99.450	$0.0795	$0.0140
65XXX	173	176.00	$0.1407	149.600	$0.1196	$0.0211
66XXX	10	22.00	$0.0176	18.700	$0.0149	$0.0026
69XXX	5	35.00	$0.0280	29.750	$0.0238	$0.0042
71XXX	374	406.00	$0.3245	345.100	$0.2758	$0.0487
72XXX	1179	1249.00	$0.9984	1061.650	$0.8486	$0.1498
TOTAL	4310	4542.00	$3.6306	3864.903	$3.0893	$0.5412
MDS TOT	7668					

2nd DESTINATION TRANSPORTATION COST SAVINGS = $0.5412

2nd DESTINATION TRANSPORTATION COSTS
FOR THE LELAND PROPOSAL
(in Millions)

MDS TOTAL 2nd DEST. TRANSPORTATION COST = $3.6306

FACTOR 0.3

SYSTEM	===== NUMBER OF NRTS ITEMS	NUMBER NRTS AND CONDEMNED ITEMS	TRANS. COSTS	ADJUSTED NUMBER OF NRTS ITEMS	ADJUSTED TRANS. COSTS OF NRTS ITEMS	SAVINGS COST
42XXX	162	195.00	$0.1559	169.953	$0.1358	$0.0200
51XXX	916	925.00	$0.7394	647.500	$0.5176	$0.2218
52XXX	1109	1124.00	$0.8984	786.800	$0.6289	$0.2695
61XXX	132	154.00	$0.1231	107.800	$0.0862	$0.0369
62XXX	135	139.00	$0.1111	97.300	$0.0778	$0.0333
63XXX	115	117.00	$0.0935	81.900	$0.0655	$0.0281
65XXX	173	176.00	$0.1407	123.200	$0.0985	$0.0422
66XXX	10	22.00	$0.0176	15.400	$0.0123	$0.0053
69XXX	5	35.00	$0.0280	24.500	$0.0196	$0.0084
71XXX	374	406.00	$0.3245	284.200	$0.2272	$0.0974
72XXX	1179	1249.00	$0.9984	874.300	$0.6989	$0.2995
TOTAL	4310	4542.00	$3.6306	3212.853	$2.5681	$1.0624
MDS TOT	7668					

2nd DESTINATION TRANSPORTATION COST SAVINGS = $1.0624

COST OF BASE LEVEL MAINTENANCE MANHOURS
FOR THE LELAND PROPOSAL
(in Millions)

TOTAL BASE LEVEL MAINTENANCE COSTS = $49.52
ADJUSTED BASE LEVEL MAINTENANCE COSTS = $49.44

TOTAL MANHOUR COST SAVINGS = $0.0752

FACTOR 0.05
============

SYSTEM	REMOVALS	ADJUSTED REMOVALS	DELTA	MMHTR	LABOR COST	MAINTENANCE MANHOURS COST SAVINGS
42XXX	1603	1405.95	197.05	3.5	11.68	$0.0081
51XXX	2358	2240.10	117.90	5.4	11.68	$0.0074
52XXX	2345	2227.75	117.25	7.4	11.68	$0.0101
61XXX	617	586.15	30.85	5.5	11.68	$0.0020
62XXX	427	405.65	21.35	5.1	11.68	$0.0013
63XXX	499	474.05	24.95	5.4	11.68	$0.0016
65XXX	525	498.75	26.25	6.0	11.68	$0.0018
66XXX	296	281.20	14.80	3.7	11.68	$0.0006
69XXX	72	68.40	3.60	7.5	11.68	$0.0003
71XXX	2194	2084.30	109.70	6.6	11.68	$0.0085
72XXX	8558	8130.10	427.90	6.7	11.68	$0.0335
TOTAL	19,494	18,402	1091.60			$0.0752
MDS TOTAL	65,683					

COST OF BASE LEVEL MAINTENANCE MANHOURS FOR THE LELAND PROPOSAL
(in Millions)

TOTAL BASE LEVEL MAINTENANCE COSTS = $49.52
ADJUSTED BASE LEVEL MAINTENANCE COSTS = $49.31

TOTAL MANHOUR COST SAVINGS = $0.2095

FACTOR 0.15
============

SYSTEM	REMOVALS	ADJUSTED REMOVALS	DELTA	MMHTR	LABOR COST	MAINTENANCE MANHOURS COST SAVINGS
42XXX	1603	1405.95	197.05	3.5	11.68	$0.0081
51XXX	2358	2004.30	353.70	5.4	11.68	$0.0223
52XXX	2345	1993.25	351.75	7.4	11.68	$0.0304
61XXX	617	524.45	92.55	5.5	11.68	$0.0059
62XXX	427	362.95	64.05	5.1	11.68	$0.0038
63XXX	499	424.15	74.85	5.4	11.68	$0.0047
65XXX	525	446.25	78.75	6.0	11.68	$0.0055
66XXX	296	251.60	44.40	3.7	11.68	$0.0019
69XXX	72	61.20	10.80	7.5	11.68	$0.0009
71XXX	2194	1864.90	329.10	6.6	11.68	$0.0254
72XXX	8558	7274.30	1283.70	6.7	11.68	$0.1005
TOTAL	19,494	16,613	2880.70			$0.2095
MDS TOTAL	65,683					

COST OF BASE LEVEL MAINTENANCE MANHOURS FOR THE LELAND PROPOSAL
(in Millions)

TOTAL BASE LEVEL MAINTENANCE COSTS =	$49.52
ADJUSTED BASE LEVEL MAINTENANCE COSTS =	$49.11
TOTAL MANHOUR COST SAVINGS =	$0.4109

FACTOR 0.3

============

SYSTEM	REMOVALS	ADJUSTED REMOVALS	DELTA	MMHTR	LABOR COST	MAINTENANCE MANHOURS COST SAVINGS
42XXX	1603	1405.95	197.05	3.5	11.68	$0.0081
51XXX	2358	1650.60	707.40	5.4	11.68	$0.0446
52XXX	2345	1641.50	703.50	7.4	11.68	$0.0608
61XXX	617	431.90	185.10	5.5	11.68	$0.0119
62XXX	427	298.90	128.10	5.1	11.68	$0.0076
63XXX	499	349.30	149.70	5.4	11.68	$0.0094
65XXX	525	367.50	157.50	6.0	11.68	$0.0110
66XXX	296	207.20	88.80	3.7	11.68	$0.0038
69XXX	72	50.40	21.60	7.5	11.68	$0.0019
71XXX	2194	1535.80	658.20	6.6	11.68	$0.0507
72XXX	8558	5990.60	2567.40	6.7	11.68	$0.2009
TOTAL	19,494	13,930	5564.35			$0.4109
MDS TOTAL	65,683					

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Vita

Captain Theodore D. Seymour was born 12 February 1962 in Providence, Rhode Island. He graduated from East Providence Senior High School in East Providence, Rhode Island in 1980. He then attended New England College in Henniker, New Hampshire. Later, he transferred to Rhode Island College in Providence, Rhode Island, graduating with a Bachelors of Science in Management in June 1985. He entered the Air Force 24 January 1986, receiving his commission on 24 April 1986 as a graduate of the Officers Training School. After attending Aircraft Maintenance Officers Course at Chanute AFB, Illinois he served his first assignment at Pease AFB, New Hampshire. While there he performed duties as Assistant Officer-in-Charge (OIC) of the FB-111A Flightline Branch, OIC of the FB-111A Flightline Branch, OIC FB-111A Armament Systems Branch, and OIC Weapons Storage Area. While at Pease, he participated in many special events such as Red Flag 1987, Maple Flag 1988, and 1989 Giant Sword Competition (Weapons Loading Competition). He entered the School of Systems and Logistics, Air Force Institute of Technology, in June 1990.

Captain Seymour is married to the former Crystal A. Whitaker. They are the parents of two boys, Tyler and Colton.

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13. ABSTRACT *(Maximum 200 words)*
This research investigated the life cycle costs of three alternative ~~electrical~~ (TRANSPORT) power systems for a planned electrical system upgrade to the C-130 aircraft. Research identified the contractors as (1) Sundstrand, (2) Westinghouse, and (3) Leland. The literature review included discussions on the C-130, electrical power systems and the proposed alternatives, and the elements of life cycle cost analysis. In the discussion on supportability issues, this research evaluated changes in mission capable rates and the needed fleet size to perform the current mission. In estimating Operating and Support costs, this research used the analogy approach. Analogies were based on expert opinions of Air Force and industry engineers. Sensitivity analysis was then performed on these expert's predictions to help in the formation of conclusions. The system performance of all options netted similar results. However, Alternative 3 had the lowest total life cycle costs, making it the most cost effective option. This research concluded the Leland proposal to be the best choice and recommends implementation of the proposal.

14. SUBJECT TERMS
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